

Railway Mechanical Engineer

Vol. 101

May, 1927

No. 5

A prominent railroad in this country purchased during 1926 the following representative items of material:

**What a
railroad
buys**

240,000 pieces of air brake hose, 208,600 ft. of axle generator bolting, 40,500 5½-in. by 10-in. car journal boxes, 3,760 62-in. flanged locomotive tires, 60,300 2-in. boiler flues, 834 tons of ¾-in. staybolt iron, 1,120,000 ft. of 1¼-in. standard steel pipe, 55,780 freight car couplers, 87,775 scoop shovels, 100,560 wrought steel wheels, 365,865 passenger and tender brake shoes, 9,883,000 bd. ft. of oak flooring, 1,583 tons of copper bearing steel plates, 3,153,600 lb. standard freight car red paint, 41,470 square point "D"-handle shovels. These are only a few of the items of particular interest to the mechanical department. Altogether, railroad purchases help to support practically every phase of human activity.

But a few days after this issue of the *Railway Mechanical Engineer* reaches its readers, the International Rail-

**The
Fuel
Association**

way Fuel Association convention will be in session at the Hotel Sherman, Chicago. This organization, the meeting of which will be held from May 10 to 13, inclusive, is the one railway association in which mechanical department officers are interested that brings to its members a vision of railroading which is broader than the activities of their own department. In an industry which possesses as many technical ramifications as does railroading, it is inevitable that many of the important problems must be solved by specialists on the basis of considerations which are little known to those outside of their own department. This necessity, however, tends toward narrowing the vision of each technical department and this has been carried so far at times that the broader problems of the transportation industry were hardly visible over the high walls with which the departments were surrounding themselves. The problems of fuel economy are too general to belong to any single department of the railroad organization and it is the realization of this fact by the men who have been responsible for shaping the course of the International Railway Fuel Association which has made this organization such a tremendously useful instrument. Its primary job is, of course, promoting fuel economy in every sense of the word, but in meeting the requirements of that job it has become a great co-ordinator of departments. It is the one common meeting ground for railroad men of all ranks and all branches of the service. The program carries something of specific interest to each group, but not the least of the benefits to be obtained from attending the conventions of this organization are derived by those who give as much attention to parts of the program concerning the specific interests of others as they

give to the parts concerning their own specific interests. Those who attend all of the sessions cannot fail to receive a broader vision of the industry which engages them—a vision which will be of immense practical value in their own and in the industry's development.

In at least two respects, the Seaboard Air Line six-wheel switchers, which are described on another page in this issue, are of more than usual interest. While its weight of 180,000 lb. on drivers has been exceeded in the case of a few six-wheel switchers, its tractive force of 45,000 lb. is the largest on record. Its outstanding feature, however, is the use of a maximum cut-off of 65 per cent. The limited cut-off principle is now in extensive use on freight locomotives and its use in switching service where full cut-off or approximately full cut-off is utilized for a large part of the time, is relatively new. These locomotives are one of the two applications which have so far been made, the Texas & Pacific having had several limited cut-off engines in service since the beginning of the year 1926. There are two questions concerning the performance of the limited cut-off in switch engine service which are likely to arise most frequently. The first is their effect on fuel consumption, which by the very nature of the case should be marked and in the direction of improvement. The second is the snappiness of the locomotives in starting under all conditions. While more definite data will undoubtedly be available as to the relative fuel consumption later, it may be stated as a fact that a definite improvement has been effected and that their starting ability is satisfactory.

Whenever a new alloy steel possessing improved physical properties under static tests has been introduced into the locomotive forging field, it has had a fight against many odds. Constant reiteration has been required to establish firmly an understanding of the fact that abuses which have been customary in the handling of soft carbon steel become dangerous with the harder steels, whether of straight carbon or alloy analysis. Indeed the sensitiveness of some steels has led to their commercial failure and the tendency in the development of steel for this reason has been away from those requiring complicated heat treatments to bring out their desirable properties. On the other hand, there has gradually developed a knowledge of the fact that no steel should be carelessly handled without regard to its limitations, and there has been some improvement in the methods of heating, working and finishing forgings in railroad shops. Certain abuses still persist, however, and one of these is an ap-

**A common
abuse of
steels**

When a new alloy steel possessing improved physical properties under static tests has been introduced into the locomotive forging field, it has had a fight against many odds. Constant reiteration has been required to establish firmly an understanding of the fact that abuses which have been customary in the handling of soft carbon steel become dangerous with the harder steels, whether of straight carbon or alloy analysis. Indeed the sensitiveness of some steels has led to their commercial failure and the tendency in the development of steel for this reason has been away from those requiring complicated heat treatments to bring out their desirable properties. On the other hand, there has gradually developed a knowledge of the fact that no steel should be carelessly handled without regard to its limitations, and there has been some improvement in the methods of heating, working and finishing forgings in railroad shops. Certain abuses still persist, however, and one of these is an ap-

parent lack of serious attention to see that liberal fillets are always provided at changes of section in axles and pins. Another is carelessness in permitting tool marks to remain in finished surfaces. Each of these abuses still remains a cause of many failures through the development of progressive fractures. Perhaps of the two the most common and most dangerous is carelessness with respect to fillets. The day has passed when drawings are made without due regard to the need for liberal fillets. The day is far from passed, however, when careless workmanship and careless supervision result in the violation of this cardinal principle of successful forging services.

If records were kept to show the reason for every expenditure for machine tool maintenance, it would be

Machine tool lubrication

found that much of the maintenance could be traced to lack of proper lubrication, either due to poor design or to lack of the operator's attention. Many machines now in service were purchased at a time when adequate lubrication was not given the consideration it receives from many machine tool builders today. The maintenance cost of these machines should be watched closely. If this item of expense is above the average, the lubricating system should be carefully checked to determine its adequacy. If found insufficient, it should be modernized to eliminate repeated breakdowns with the attendant loss of production while the machine is out of service. This question of lubrication should be properly considered when purchasing new machine tools. While it is true that many of the machine tool manufacturers have made decided improvements in this respect in the last few years, still a number of the builders has failed to give this problem the consideration it rightfully deserves. Consequently, the railroads should not only consider those qualities of a machine that will meet their production problems, but also should determine whether the unit is adequately lubricated. More attention must be paid to the lubrication of machine tool bearings owing to the higher speeds and greater bearing pressures incidental to the high duty operation required of modern cutting tools. Are not maximum production at a minimum cost the two fundamental factors generally considered when purchasing most machine tools? Is it possible consistently to obtain maximum utilization from a machine tool that is not provided with an efficient lubricating system?

A large number of air brake men are now making their plans to attend the thirty-fourth annual convention of

The thirty-fourth Air Brake convention

the Air Brake Association which is to be held at Washington, D. C., May 24 to 27, inclusive. This association is international in scope and educational in character. Its membership is representative of practically all the railroads in the United States and Canada, and it has members in Mexico and several other countries. It has exerted a powerful influence toward obtaining improved train brake operation and maintenance. There has been a steady increase in attendance at its annual conventions which has also been accompanied by a corresponding improvement in the quality of the reports and papers and in the character of the exhibits.

One of the features that has been peculiar to the work of the Air Brake Association since it was organized in Pittsburgh, Pa., in 1893, has been the policy of holding its convention in a different section of the country each

year. The first convention was held in Columbus, Ohio, in 1894 and since that time the association has travelled as far north as Montreal, Que., where it met in 1906 and again in 1924; as far west as Los Angeles, Cal., in 1925; south as far as Jacksonville, Fla., in 1900, and east to Atlantic City, N. J., where it met in 1922. Never but once has the association held its convention in the same city for two or more consecutive years; in 1919, 1920 and 1921, the conventions were held at Chicago. This roving policy has not only been a source of benefit to the members attending the conventions by giving them an opportunity to observe brake operation on roads in different parts of the country under widely varying conditions, but it has also been a considerable factor in obtaining an enrollment representative of the air brake men from all sections of the country. The 1926 convention, which was held at New Orleans, La., was the largest in the history of the association, the final registration showing a total of 852 members and guests in attendance.

The outstanding report presented and discussed at the last convention was undoubtedly that of the committee on Brake Pipe Leakage. The report that this committee will present this year at Washington will be the result of three years' intensive work and it can be said without qualification that the specific conclusions and recommendations that have already been prepared will be an important factor toward obtaining better train brake operation through more economical utilization of air compressor capacity. Two subjects of recent development come before the association for the first time this year; namely, "Recommended practice on air brakes and foundation brake gear for gas rail cars" and "Air brakes for automotive vehicles."

Considering the real value of the work that the Air Brake Association has already accomplished and the character of the program that has been planned for this year's convention, the thirty-fourth convention will, undoubtedly, be one of the most important conventions it has ever held.

The use of nitrocellulose lacquers by the railroads, although it probably constitutes a relatively small part of

Two lacquer problems

the present market, is progressing rapidly. There are probably few railroads that have not already displayed some interest in this new finishing material. Its advantages of quick drying and complete chemical inertness offer possibilities for reduced shop time and increased durability which have great economic value. There are, however, two conditions unfavorable to the immediate success of lacquer. One of these is that the material works so differently from oil paints and varnishes that a somewhat different technique is required in its application. This is the cause of a considerable prejudice in the paint shop which can only be removed by educational effort, aided by the gradual development of facilities adapted especially to the requirements of lacquer. The other unfavorable condition lies in the fact that there are at present some seventy or more producers of nitrocellulose lacquers. This situation is the direct result of the immediate success of the first lacquer, which was introduced under the trade name of Duco. Until all railroads interested in the possibilities of lacquer for finishing the exterior realize that there may be as wide a variation in the qualities and properties of the lacquers of these approximately seventy separate producers as they have learned to expect in the products of various oil paint and varnish manufacturers, there is danger that the failure of one or more lacquer products will lead to the conclu-

sion that the entire lacquer principle is incorrect and all such materials worthless. It must be kept clearly in mind that while many of these products will, no doubt, prove entirely reliable, it is only reasonable to expect that some will prove unreliable just as some oil paints and varnishes have proved unreliable for railroad use.

There is altogether too much guesswork in the operation of the average steam locomotive on American railroads to

Guesswork in locomotive operation

assure desirable results, particularly as regards fuel economy. The difficulty is not so much one of incompetent enginemen as simply that in the vast majority of cases the steam gage is the only mechanical aid which the engineman has of knowing what actual locomotive operating conditions are. Often there is absolutely no means provided for him to know the actual steam pressure available in the steam chests, the back pressure against which the locomotive is working, or any one of a number of other vital factors of which the amount of back pressure gives a reliable indication. The engineman depends largely upon his senses of sight, hearing and feeling to determine whether the locomotive is operating with the proper cut-off for the given set of conditions, and it is no particular reflection on him to say that his judgment may not always be the same from day to day, nor is it likely to agree with that of other enginemen.

The possibility of costly mistakes in judgment is indicated by the fact that under certain conditions a difference in position of the reverse lever of one notch may make a difference of 20 per cent in coal consumption. Cases have been known where locomotives, operating with 200 lb. boiler pressure, were getting but 80 lb. pressure in the cylinders, simply because the enginemen did not know what the conditions were. It is time that determined and general efforts be made to eliminate guesswork in locomotive operation as far as possible.

That much of the guesswork can be eliminated seems to be a demonstrated fact. Back pressure is generally accepted as accurately reflecting the efficiency of locomotive operation, and extensive experience has demonstrated the practicability of improving this operation by letting the engineman know what the back pressure is so that he can govern the reverse lever position and cut-off accordingly. The single back pressure gage tells the engineman much that he needs to know; the combination initial and back pressure gage tells him more; a number of able mechanical department officers feel that the engineman also needs the assistance of an automatic cut-off control device, based on a predetermined constant back pressure.

Whichever alternative is chosen, the value of some additional mechanical aid to tell the engineman what actual operating conditions are, cannot be questioned. At the last convention of the International Railway Fuel Association, C. W. Wheeler, then supervisor of fuel and locomotive performance of the New York Central, mentioned a test in which the installation of a back pressure gage made possible a marked improvement in operation. On the first of two comparative runs, a freight locomotive was operated in accordance with ordinary practice, handling a tonnage train, with an "average" engineman at the throttle. The coal consumed per 1,000 gross ton-miles was 91.7 lb.; the average cut-off, 41.6 per cent; the average throttle position, 68 per cent open; and the average steam pressure, 193.3 lb. On completion of the run a back pressure gage was applied to the locomotive with instructions to the engineman to operate with a wide open throttle and a cut-off adjustment to keep the back pressure as low as possible. With similar conditions as

regards weather and other factors, the coal consumed per 1,000 gross ton-miles on the second run dropped to 69.9 lb., the average cut-off being 31 per cent; the average throttle opening, 88 per cent; and the average steam pressure, 197 lb. Mr. Wheeler pointed out that 1,800 lb. of coal were saved on this trip which at three round trips per week and 52 weeks per year would amount to 300 tons of coal.

Experience on a number of roads, notably the Union Pacific, indicates that in addition to fuel economy, the use of initial and back pressure gages is an aid in detecting worn cylinder and valve packing, creeping power reverse gears, too small exhaust nozzles, restricted steam passages and other undesirable locomotive conditions, sometimes difficult to detect by the sound. A desirable effect on the personnel is also observed. Nothing blocks progress as much as ignorance. Give the average engine crew the means of knowing what they are doing and if past experience is any criterion, the improvement in results will be surprising.

New Books

LOCOMOTIVE CYCLOPEDIA.—The 1927 edition, 1,372 illustrated pages, 9 in. by 12 in. Price: Leather binding, \$7.00; cloth binding, \$5.00. Published by the Simmons-Boardman Publishing Company, 30 Church street, New York.

The eighth edition of this book has been revised and edited to cover by words and illustrations the modern locomotive and its auxiliaries and also the equipment and practices employed in its maintenance. In the locomotive section a number of tables have been included which give the principal dimensions and proportions of the different types of locomotives acquired by the American railroads during the past two years. The numerous line drawings in the cyclopedia have been revised to cover the outstanding improvements in design made since the last edition of the cyclopedia. For the convenience of the reader, the book has been more completely sectionalized and the indices have been amplified and improved for reference purposes. An entirely new shop and engine terminal section has been included in this edition of the book. This section, which has been written by W. H. Markland, general shop inspector, Altoona Works, Pennsylvania Railroad, contains line drawings showing the layout and the arrangement of machine tools and shop equipment of some of the modern shops and engine terminals of recent construction. The rest of the section is devoted to a description of the construction, operation and utilization of machine tools and shop equipment in railway shops. The text pages are profusely illustrated with actual views of typical railroad jobs.

History of the Eleventh Engineers U. S. A. Published by the Trustees Eleventh Engineers' Fund, New York. Bound in cloth, 539 pages, 5 in. by 8 in.; illustrated.

This book is a history of the organization, training, overseas work and final demobilization in May, 1919, of the first regiment of U. S. Railway Engineers to reach France. Part I of the book is devoted to a narrative of happenings in chronological order. Part II outlines the military engineering and construction work in some detail. The text of this book, the excellent illustrations, soldier-drawn cartoons and army maps make the book a valuable record of the services of U. S. railway engineers in the World War. The book has been published in a limited edition and will not be put on sale, but a few extra copies have been printed for libraries or for persons especially interested in such historical matter.

"Northern Pacific" type locomotives

Boiler pressure of 210 lb. can be increased to 225 lb. if desired—Firebox designed for low grade fuel

—Tractive force, 57,500 lb.

ATENTION was called in the February, 1927, issue of the *Railway Mechanical Engineer* to the twelve 4-8-4 type locomotives ordered by the Northern Pacific, the first of which was delivered late in December, 1926. These locomotives were placed in passenger service between Jamestown, N. D., and Glendive, Mont., and between Livingstown, Mo., and Missoula. The last named division runs through mountainous territory and has grades as high as 2.2 per cent.

These locomotives develop a tractive force of 57,500 lb. without the booster, which provides an additional starting tractive force of 11,400 lb. The boiler carries a pressure of 210 lb. per sq. in. and the diameter and stroke of the cylinders is 28 in. by 30 in. The diameter of the driving wheels is 73 in. Trial runs made with these locomotives have shown that they are capable of hauling nine steel passenger cars up a 2.2 per cent grade without a helper and also of hauling unassisted 11 steel passenger cars over Bozeman Mountain on the Livingston-Missoula division, which has a grade of 1.8 per cent, at sufficient speed to maintain the schedule.

Conditions affecting the design

The design of the 4-8-4 type locomotive was the result of study on the part of the railroad company in co-operation with the builders to produce a locomotive of the best design and proportions to meet the operating conditions just described. The 2.2 per cent grade over which these locomotives operate was a factor in determining the tractive force of 57,500 lb., which with the addition of the trailer booster, is increased to 68,900 lb., which is a great advantage for starting or operation at slow speed over the maximum mountain grade. The weight carried on the drivers is 260,000 lb. which gives a factor of adhesion of 4.52. Although the pressure carried at the present time is 210 lb., the boilers and machinery are designed to carry a working pressure of 225 lb., so that if it is later desired to go to 225 lb. boiler pressure, in certain territory, the locomotive will develop a tractive force of 61,600 lb. exclusive of the booster, and a total tractive force of 73,975 lb. with the booster in operation.

The character of the sub-bituminous (Rosebud) coal

used, which is of comparatively low B.t.u. content, had considerable influence in the design of the boiler and firebox. An exceptionally large grate area and firebox is required to satisfactorily burn this fuel. A total grate surface of 115 sq. ft. is provided, but it is the intention when burning a better grade of coal to reduce the grate area to about 95 sq. ft. To reduce the grate area, a temporary brick wall is installed on the grate bars in the front end of the firebox as shown in the elevation drawing. A steel plate cover is bolted to the grates under-

neath the temporary wall and is secured around the sides of the firebox in such a way as to prevent leakage of air. The installation is such, however, that the grates may be rocked when the wall is removed. The grates have been installed as nearly level as possible, which is considered the best practice when burning Rosebud coal. The firebox is built with a drop of only four inches in the mud ring from the back to the front end.

The long overhang at the rear end which resulted from the adoption of this large firebox, made it necessary to use a four-wheel trailer truck to carry the weight. Type B duPont-Simplex stokers are used, with the stoker engine located on the tender, which relieves the rear end of the locomotive of that item of weight. Q. & C.

cast steel grate bars are applied instead of the customary cast iron. With the most careful designing, however, the weight on the trailer truck is 104,000 lb.

Boiler of large proportions

The boiler is of the wide firebox, conical-connection type, with a firebox 162 in. long by 102¼ in. wide. The combustion chamber is 74½ in. long. The total evaporative surface of the boiler is 4,600 sq. ft., which with the addition of the Type E superheater surface of 1,992 sq. ft., gives a combined evaporative and superheating surface of 6,592 sq. ft. The smoke box is provided with a Mudge Security Unit spark arrestor and a single exhaust pipe with a nozzle 7 in. in diameter.

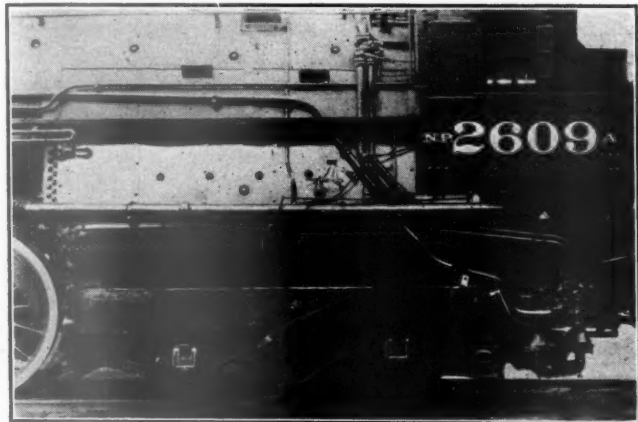
The bracing used in the boilers of these locomotives is of the builder's standard design and consists of brace rods formed without welds and lugs made from flanged



Front end of the "Northern Pacific" type locomotive

plate. The element of uncertainty relative to the strength of the welds is eliminated by the use of brace rods made of a single piece, instead of using jaws on each end of the rod which have been built up by welding. Lugs on the boiler shell made from flanged plate also avoid an element of uncertainty present in the case of drop forged lugs. Plate metal can be worked at a lower temperature without danger of burning.

Steam distribution is controlled by a Baker valve gear, designed for 87 per cent maximum cut-off and a Precision reverse gear. The cylinders are of cast steel and all steam cavities are designed to be self-draining. The



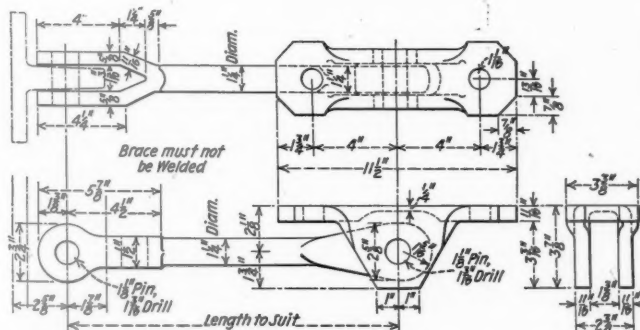
The trailer truck and firebox

stoker engine, dynamo, booster, blower and air compressor are operated with superheated steam.

The running Gear

The total weight of the engine is 426,000 lb. of which 260,000 lb. is carried on the drivers; 62,000 lb. on the front truck and 104,000 lb. on the trailing truck. The total driving wheel base is 20 ft. 3 in. and the total wheel base of the engine is 47 ft. 2 in.

The engine truck is the constant resistance type having a Commonwealth cast steel frame cast in one piece.

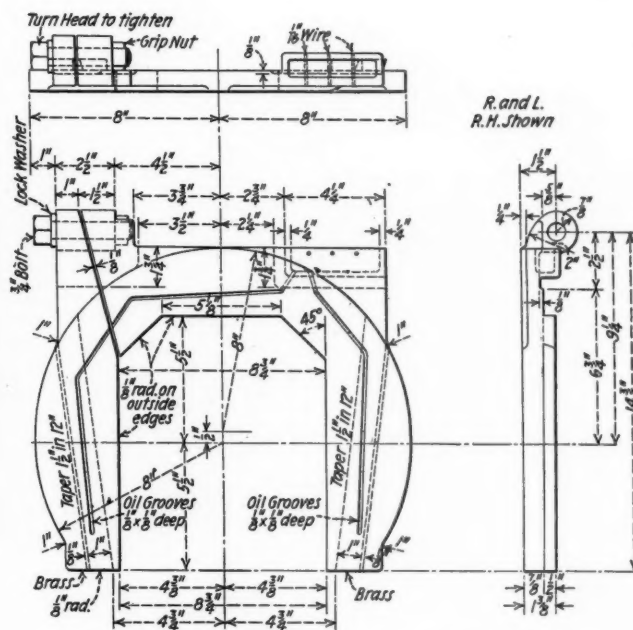


Design of longitudinal bracing used in the boiler construction

It has 36-in. diameter wheels with 7½-in. by 14-in. journals, provided with removable hub-liners. They are held in position against the face of the box by two projections, cast integral with the liner, which make a dovetail fit in corresponding grooves in the face of the box. The two sections are held in place by a ¾-in. bolt, so located as to facilitate the removal of the liner. The engine truck axles are of forged steel, hollow bored.

All of these locomotives are equipped with Hubbard manganese steel crossheads. The frames are of high test vanadium cast steel. The front drivers are equipped

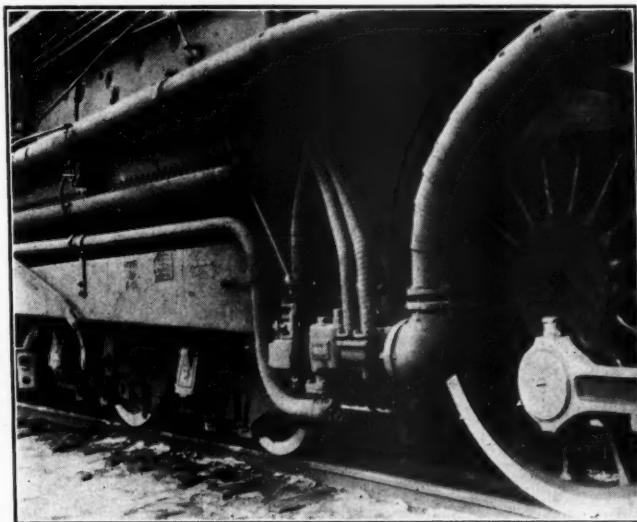
with the Alco lateral motion device. The main driving boxes are fitted with supplemental bearings which extend below the horizontal center line of the journal to oppose the rapid wear below that line caused by the reciprocating piston thrusts. All of the driving wheel hubs, as well as the trailing truck hubs, are equipped with Smith adjustable hub liners made of Hunt-Spiller



Removable hub liner used on the engine truck box

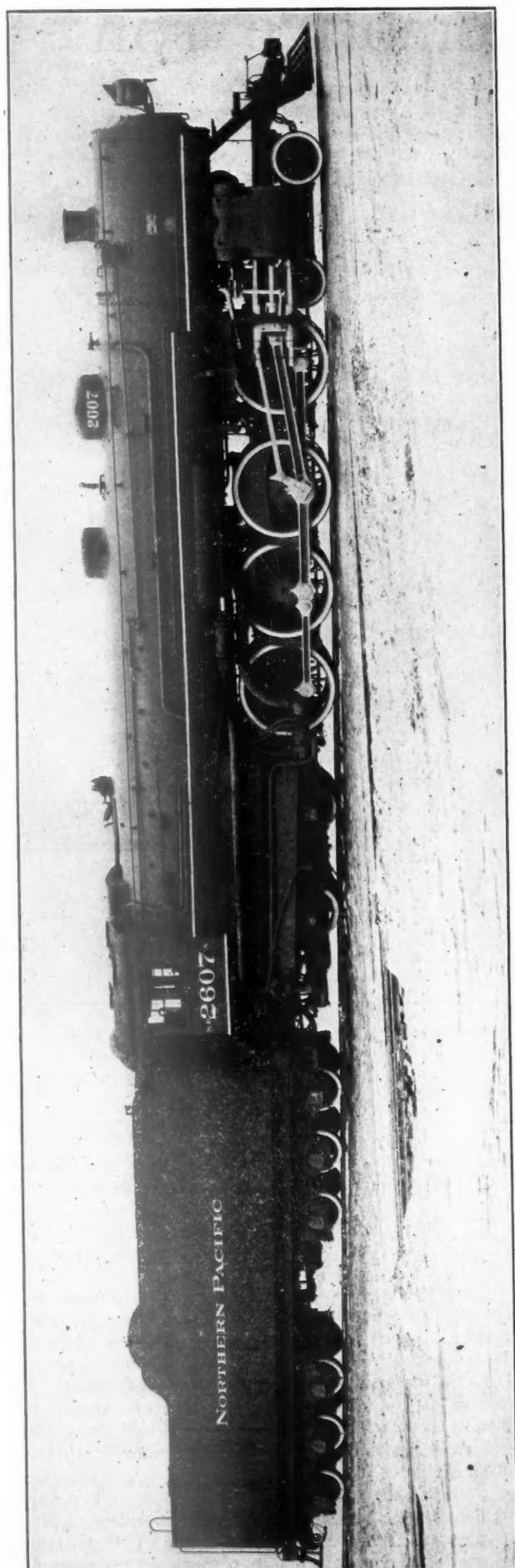
gun iron. The back end of main rods are equipped with floating bushings which work in Hunt-Spiller gun iron bushings pressed into the rod. All the crank pins, including the main, are hollow bored.

The four-wheel trailer truck is the Commonwealth Delta type having 36-in. wheels at the front and 45¾-in.



The cradle casting is outside the trailer frame—The exhaust steam injector is in the foreground

wheels at the rear. The front axle is arranged to float laterally in the journal boxes as they do not assist in guiding the locomotive around curves. A Franklin booster, the exhaust of which is carried forward to the cylinder saddle, drives on the rear axle. A special design of the Commonwealth frame cradle was required in



The Northern Pacific 4-8-4 type locomotive built by the American Locomotive Company

order to obtain the best possible ash pan capacity to meet the conditions imposed by the practically level mud ring of the firebox and by the four-wheel trailer truck. The rails of the cradle are located outside the wheels which gives it an overall width about equal to the outside width of the firebox.

Special equipment

Each locomotive is equipped with an Elesco exhaust steam injector; American type multiple disc throttle valves built into the superheater header castings; Ashcroft cut-off control gages; Weston speed indicator and Hoofer ratchet type flange oilers. Six of the locomotives are finished with Duco lacquer.

The tender

The tender, which has a capacity of 15,000 gal. of water and 24 tons of coal, is carried on two Commonwealth six-wheel trucks. The wheels are 37-in. in diameter and have 6½-in. by 12-in. journals. The tender frame is also a Commonwealth steel casting.

Table of dimensions, weights and proportions of the "Northern Pacific" (4-8-4) type locomotive

Railroad.....	Northern Pacific
Builder.....	American Locomotive Co.
Type of locomotive.....	4-8-4
Service.....	Passenger
Cylinders, diameter and stroke.....	28 in. by 30 in.
Valve gear, type.....	Baker
Valve, piston type, size.....	14 in.
Maximum travel.....	9 in.
Outside lap.....	1½ in.
Exhaust clearance.....	¾ in.
Lead in full gear.....	½ in.
Cut-off in full gear, per cent.....	88.88
Weights in working order:	
On drivers.....	260,000 lb.
On front truck.....	62,000 lb.
On trailing truck.....	104,000 lb.
Total engine.....	426,000 lb.
Tender.....	313,900 lb.
Wheel bases:	
Driving.....	20 ft. 3 in.
Total engine.....	47 ft. 2 in.
Total engine and tender.....	90 ft. 0 in.
Wheels, diameter outside tires:	
Driving.....	73 in.
Front truck.....	36 in.
Trailing truck, front.....	36 in.
Trailing truck, rear.....	45¾ in.
Journals, diameter and length:	
Driving, main.....	12½ in. by 14 in.
Driving, others.....	11½ in. by 14 in.
Front truck.....	7½ in. by 14 in.
Trailing truck, front.....	7 in. by 14 in.
Trailing truck, rear.....	9 in. by 14 in.
Boiler:	
Type.....	Conical
Steam pressure.....	210 lb.
Fuel, kind.....	Sub-bituminous
Diameter, first ring, inside.....	82½ in.
Firebox, length and width.....	162 in. by 102¾ in.
Combustion chamber, length.....	74½ in.
Tubes, number and diameter.....	33-3½ in.
Flues, number and diameter.....	182-3½ in.
Length over tube sheets.....	21 ft.
Grate area.....	115 sq. ft.
Heating surfaces:	
Firebox and comb. chamber.....	430 sq. ft.
Arch tubes.....	55 sq. ft.
Tubes and flues.....	4,115 sq. ft.
Total evaporative.....	4,600 sq. ft.
Superheating.....	1,992 sq. ft.
Comb. evaporative and superheating.....	6,592 sq. ft.
Tender:	
Water capacity.....	15,000 gal.
Fuel capacity.....	24 ton
General data estimated:	
Rated tractive force, 85 per cent.....	57,500 lb.
Rated tractive force of booster.....	11,400 lb.
Rated tractive force, with booster.....	68,900 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent.....	61.00
Weight on drivers ÷ tractive force.....	4.52
Weight on rear trailer wheels ÷ tractive force of booster.....	5.26
Total weight engine ÷ comb. heat. surface.....	64.6
Boiler proportions:	
Tractive force ÷ comb. heat. surface.....	8.72
Tractive force x diam. drivers ÷ comb. heat. surface.....	637
Heat. surface, firebox and arch tubes ÷ grate area.....	4.22
Heat. surface, firebox and arch tubes, per cent of evap. heat. surface.....	7.36

Metallurgy of locomotive iron and steel

With reference to heat treating and the physical properties desirable for locomotive use

By Fred Williams

Assistant test engineer, Canadian National, Montreal

AT infrequent intervals the mechanical department of a railroad is faced with the problem of trying to determine the cause of an epidemic of broken staybolts, crown bolts, springs, or other parts. The first step generally taken when making such an investigation, is to determine that the design is correct and that the part has been properly applied. If this investigation does not reveal the trouble, then it is necessary to examine in the laboratory by means of the microscope the structure and physical properties of the materials from which the various parts are made. The photomicrographs often reveal some surprising conditions. They point particularly to the importance of proper heat treatment of anything but mild carbon steel.

The photo micrographs shown in Fig. 1 and 2 show

as a virtue is very much misrepresented. Some people claim that these streaks of slag will stop progressive fracture or, at least, delay it or make a ragged fracture when the iron breaks. An appeal to reason in scanning the photographs shown in Fig. 1 and 2 cannot help but

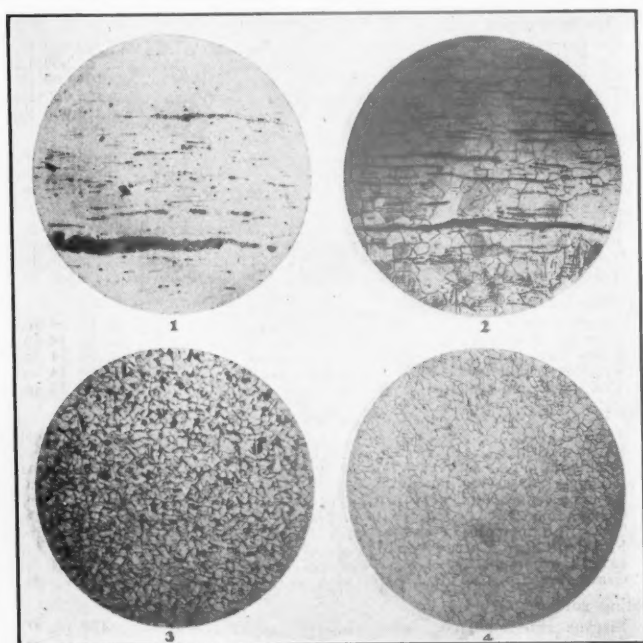


Fig. 1—Wrought iron, unetched

T. S., 47,750 lb.; Elong., 36.5%
El. L., 35,000 lb.; R. A., 57.0%
Brinell, 90; Mag., 100

Fig. 3—Low carbon steel

T. S., 63,200 lb.; Elong., 37.5%
El. L., 43,300 lb.; R. A., 69.0%
Brinell, 112; Mag., 100

Fig. 2—Wrought iron, etched

Mag. 100

Fig. 4—Very low carbon steel

T. S., 52,200 lb.; Elong., 43%
El. L., 39,650 lb.; R. A., 79%
Brinell, 99; Mag., 100

the impregnation of slag in wrought iron. These streaks or slivers of slag are what cause the so-called "fiber" in this material. This slag is necessarily brittle and when the iron is bent, it will naturally disintegrate and allow the iron to come apart and give the appearance of a rope-like structure in the bar. Slag in iron

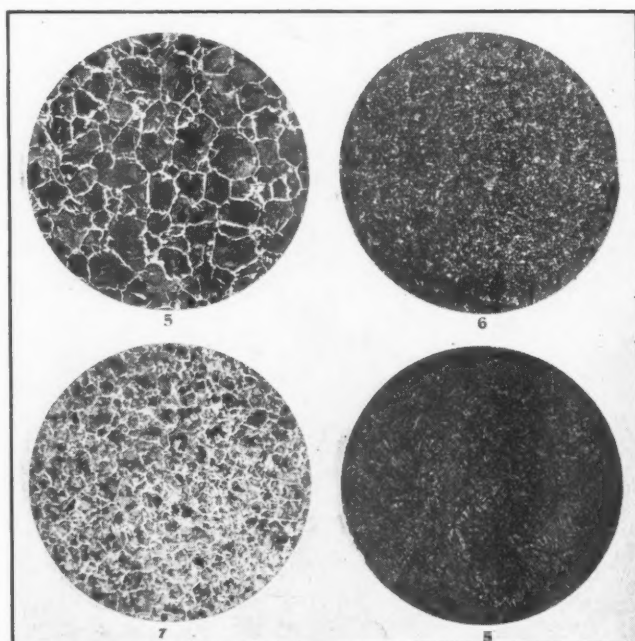


Fig. 5—Carbon steel .40, as rolled

T. S., 98,955 lb.; Elong., 24.5%
El. L., 67,250 lb.; R. A., 53.0%
Brinell, 196; Mag., 100

Fig. 7—Carbon .30, 1.25 ni. ch., as rolled

T. S., 110,700 lb.; Elong., 22.5%
El. L., 88,810 lb.; R. A., 59.0%
Brinell, 222; Mag., 100

Fig. 6—Carbon steel .40, heat treated

T. S., 135,800 lb.; Elong., 20.0%
El. L., 103,450 lb.; R. A., 55.5%
Brinell, 311; Mag., 100
Quenched from 1,500 deg. F. in water; drawn at 800 deg. F.

Fig. 8—Carbon .30, 1.25 ni. ch., heat treated

T. S., 173,300; Elong., 15.5%
El. L., 167,900 lb.; R. A., 54.5%
Brinell, 345; Mag. 100
Quenched from 1,475 deg. F. in water; drawn at 800 deg. F.

show that a progressive fracture would be caused internally and also in the surface by these slag particles and streaks. In spite of these so-called fibrous qualities of wrought iron, experience has been that staybolts made of this material will generally break off short. A comparison of the crystallographic structure shown in Fig. 2 with those shown in Figs. 3 and 4, will show that wrought iron has a crystalline structure similar to low carbon steel.

Fig. 3 shows the uniformity of structure in low carbon steel. Its low carbon will give uniform structure and it does not require heat treatment. Therefore, it can be used for engine bolts in preference to wrought

iron. In fact, it can be headed much more readily than wrought iron, as it will not split in heading. Neither will it become brittle under the head, which is the case in bolts manufactured from higher carbon steel when not subjected to subsequent heat treatment. Fig. 4 shows the clean character of very low carbon steel and also the similarity in the crystalline structure to the wrought iron shown in Figs. 1 and 2. A comparison of the physical properties of Figs. 1 and 2 with Figs. 3 and 4, will show their adaptability to their various purposes.

Figs. 5 and 6 show how essential it is to heat treat carbon or alloy steels after they have been subjected to the various mechanical workings. It will be noted that the structure of the rolled bar, Fig. 5, contains very large

deg. lower temperature for the nickel steel than for the carbon, and yet the physical properties are very much better in the nickel steel than in the carbon. The elongation is not as great nor is the reduction of area, but the tensile strength is much greater. For this reason this

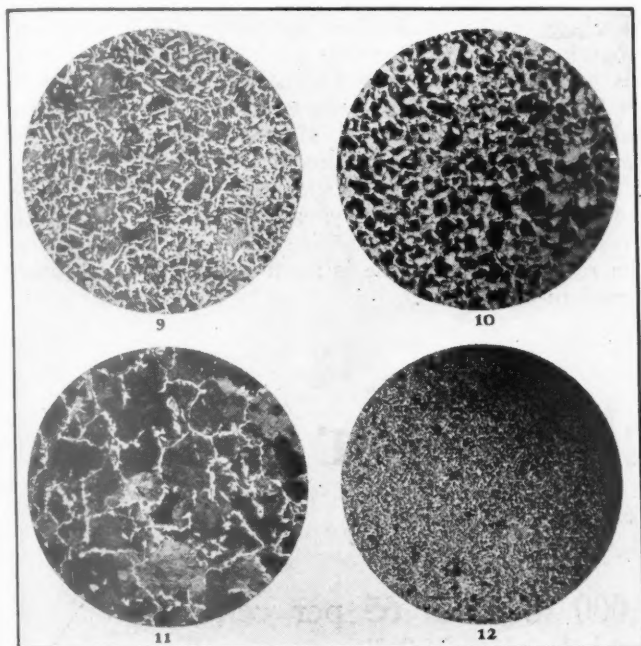


Fig. 9—Carbon steel .40, as forged

T. S., 90,300 lb.; Elong., 23.5%
El. L., 51,600 lb.; R. A., 44.0%
Brinell, 158; Mag., 100

Fig. 11—Carbon vanadium, as forged

T. S., 118,900 lb.; Elong., 3.5%
El. L., 103,300 lb.; R. A., 10.0%
Brinell, 286; Mag., 100

Fig. 10—Carbon steel .40, annealed 1,600 deg. F.

T. S., 89,300 lb.; Elong., 28%
El. L., 49,500 lb.; R. A., 50%
Brinell, 150; Mag., 100

Fig. 12—Carbon vanadium, single normalized

T. S., 119,600 lb.; Elong., 18.0%
El. L., 80,950 lb.; R. A., 40.3%
Brinell, 235; Mag., 100
Normalized at 1,600 deg. F.

crystals and that they are so interspersed that planes of weakness are set up. This necessarily makes a very poor transverse tensile strength and also leads to brittleness.

Fig. 6 shows the same bar after being subjected to the heat treatment indicated in the caption. The structure is very uniform and dense. The physical properties have been improved. The heat treatment given above is to show the maximum physical properties that can be obtained from common carbon steel for use as superheater bolts and studs. The high elastic limit is obtained in order that the bolts will not stretch during installation.

Character of alloy steels

Figs. 7 and 8 are shown as a comparison of 30 per cent carbon, 1¼ per cent nickel-chrome steel with the 30 per cent carbon steel shown in Figs. 5 and 6. The only difference in heat treatment of the carbon steel and those shown in Figs. 7 and 8, is a matter of 25

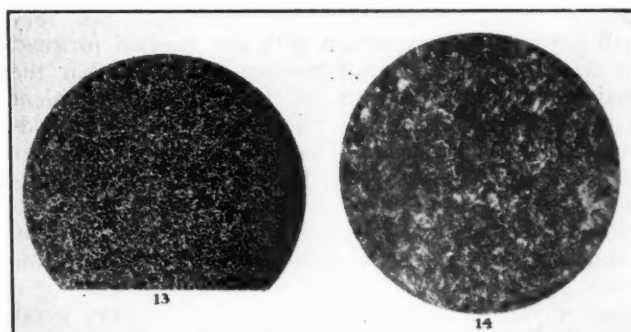


Fig. 13—Carbon vanadium, double normalized

T. S., 114,400 lb.; Elong., 22%
El. L., 77,270 lb.; R. A., 50%
Brinell, 222; Mag., 100
Normalized at 1,600 deg. F.,
Drawn at 1,250 deg. F.

Fig. 14—Carbon spring steel, as rolled

T. S., 52,200 lb.; Elong., 43%
El. L., 86,800 lb.; R. A., 1%-23%
Brinell, 289; Mag., 100

steel is recommended for any purpose where a high tensile steel is required such as superheater bolts or similar purposes. Neither the carbon steel nor the nickel steel should be used in the unheat treated condition. This

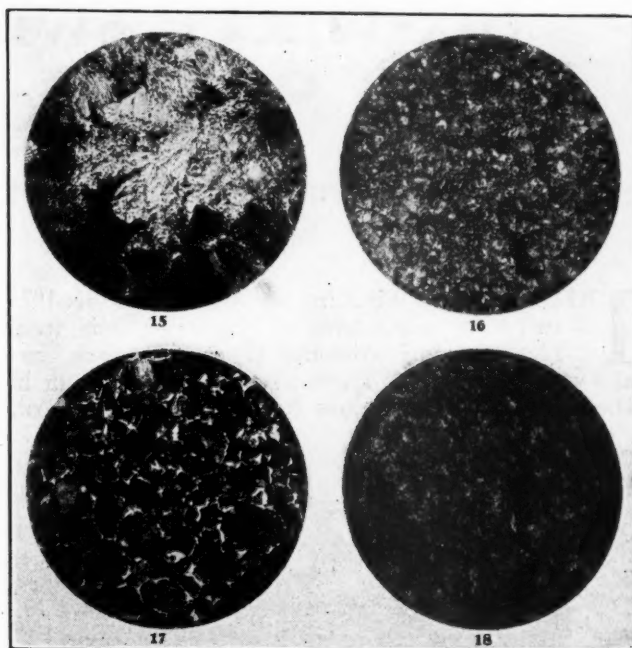


Fig. 15—Carbon spring steel, as rolled

Mag. 730

Fig. 16—Carbon spring steel, heat treated

T. S., 213,000 lb.; Elong., 8%
El. L., 150,000 lb.; R. A., 1%
Brinell, 384; Mag., 100
Quenched from 1,500 deg. F. in water, drawn at 800 deg. F.

Fig. 17—Chrome-vanadium spring steel, as rolled

T. S., 132,000 lb.; Elong., 18.5%
El. L., 82,300 lb.; R. A., 38.0%
Brinell, 262; Mag., 100

Fig. 18—Chrome-vanadium spring steel, heat treated

T. S., 215,200 lb.; Elong., 11.5%
El. L., 197,500 lb.; R. A., 32.5%
Brinell, 430; Mag., 730
Quenched in water from 1,550 deg. F., drawn at 800 deg. F.

can readily be seen by the crystalline structures shown in Figs. 7 and 8.

Figs. 9 and 10 show how severe mechanical working

under the hammer will change the structure of the material and how a subsequent annealing will make a very uniform material by eliminating the planes of weakness and non-uniformity shown in Fig. 9. It can be readily seen how the material is made more uniform throughout its mass by this annealing. It must be understood that these photomicrographs and test specimens are very small portions in comparison with the finished forging, and therefore, it does not necessarily imply that the physical properties shown in Fig. 9 are prevalent throughout the forging, but they vary greatly in hardness and tensile strength. There is assurance that after annealing the material it will be homogeneous throughout the mass and the physical results obtained after this annealing will be very nearly alike in different portions of the forging. The mechanical strains are also eliminated.

Carbon-vanadium forging steel will give very good results if the proper heat treatment is given the forging. Fig. 11 shows that the grain structure is large and that planes of weakness are prevalent. By thorough normalizing, the material is changed to a very homogeneous, compact or dense structure and the forging strains are relieved. Fig. 12 shows the structure from a single normalizing. Fig. 13 does not show much difference from Fig. 12 but it should be noticed that the elongation

and the reduction of the area are increased appreciably.

Characteristics of spring steel

If a spring steel is not given a uniform heat treatment, the structure shown in Fig. 14 will not be obtained throughout the spring bar. It will be more or less made up of crystals of different sizes and hardnesses. This is shown in Fig. 15 which is magnified 730 diameters to show the hard Martensitic structure which would be prevalent in spots in incorrectly heat treated spring steel. Fig. 16 shows a uniform Martensitic structure throughout the spring leaf. Note the large difference between the ultimate tensile strength and the elastic limit of this carbon spring steel.

Non-uniformity is just as liable to happen in chrome-vanadium spring steel when not made and heat treated properly, as in carbon spring steel. Fig. 17 shows crystals of various sizes and hardnesses when the steel is not heat treated. Fig. 18 shows a very dense structure and a uniform display of Martensite throughout the material, due to proper treatment. There is but a small difference between the elastic limit and the ultimate tensile strength of chrome-vanadium spring steel, which is one of the main assets of this steel for spring purposes. The resistance to fatigue is another feature of chrome-vanadium spring steel.

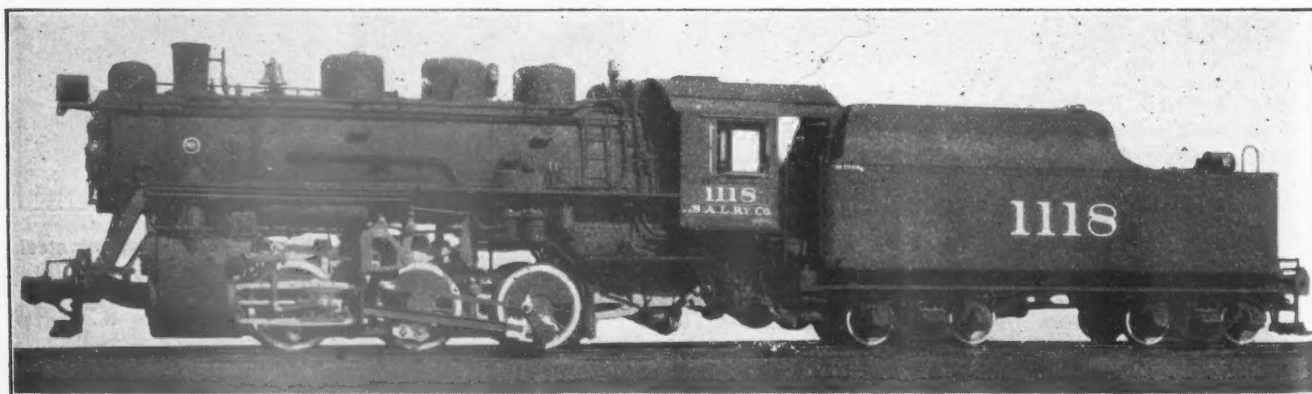
Six-wheel switchers for the Seaboard Air Line

Maximum tractive force of 45,000 lb. with 65 per cent limited cut-off—Total weight, 180,000 lb.

THE Seaboard Air Line has recently received 25 switching locomotives of the 0-6-0 type from The Baldwin Locomotive Works for use in general switching service. These locomotives were built in accordance with specifications furnished by the railroad

205 lb. per sq. in. and the diameter and stroke of the cylinders is 23 in. by 28 in.

The maximum tractive force of these locomotives is developed when cutting off at 65 per cent of the stroke, which is accomplished by setting the valves with an out-



Six-wheel switcher built for the Seaboard Air Line by The Baldwin Locomotive Works

company and are designated as Class F-7. The total weight of the engine, without the tender, is 180,000 lb. They develop a maximum tractive force of 45,000 lb., which ranks these locomotives among the most powerful of their type thus far built. The outside diameter of the driving wheels is 51 in. The boiler working pressure is

side steam lap of $2\frac{1}{2}$ in. and a maximum travel of $8\frac{3}{4}$ in. The lead in full gear and the exhaust clearance are each $\frac{1}{8}$ in. The valve gear is of the Baker type, controlled by the Ragonnet power reverse mechanism. The cylinder barrels are bushed with gun iron and are lubricated by a Nathan mechanical lubricator. Carbon vana-

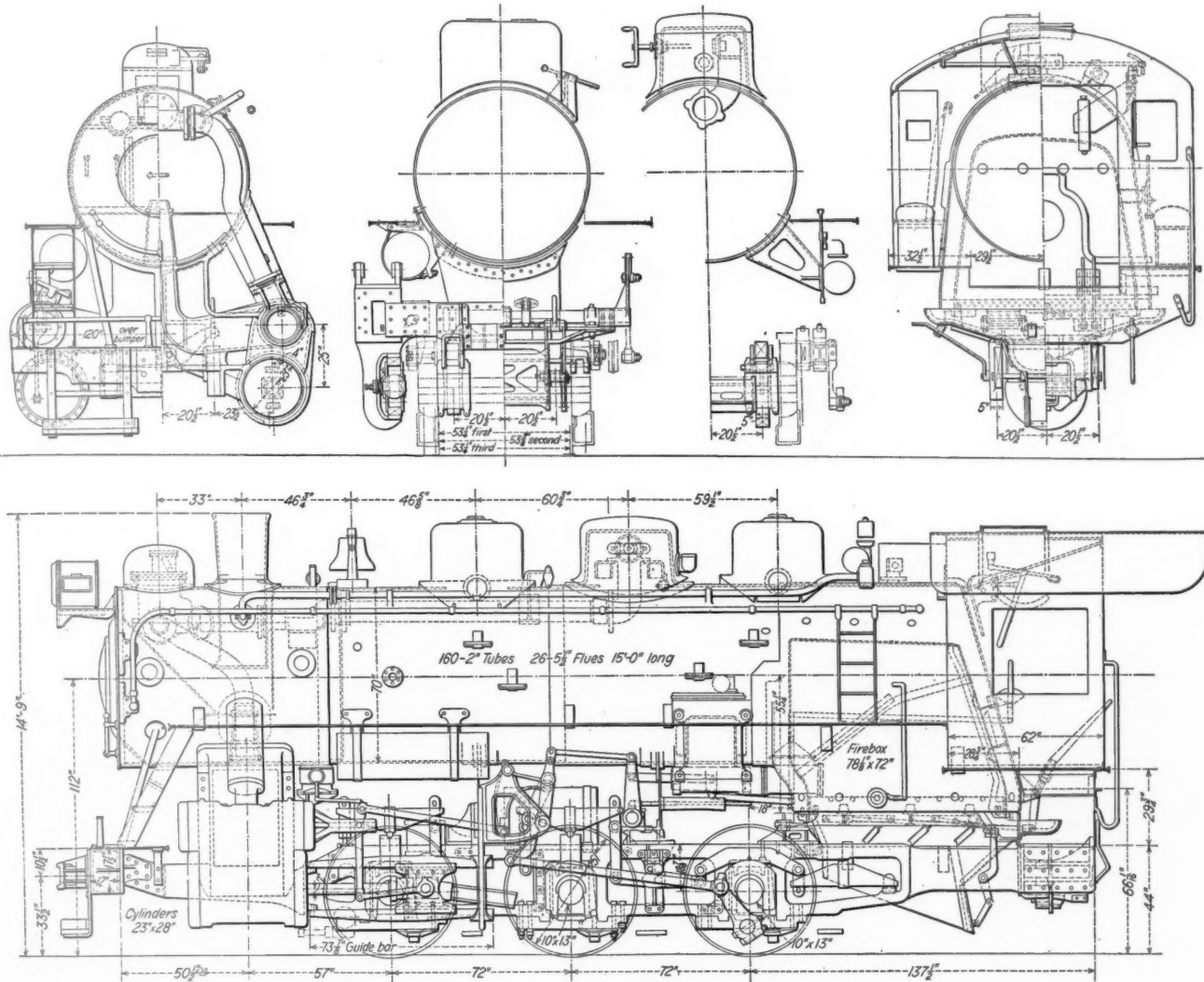
dium steel is used for the piston rods, main and side rods, crank pins, and driving axles which are hollow bored.

These locomotives are designed to traverse curves up to and including 22 deg. All the driving wheel tires are

Table of dimensions, weights and proportions of the Seaboard Air Line 0-6-0 type switchers

Railroad.....	Seaboard Air Line
Builder.....	Baldwin Locomotive Works
Type of locomotive.....	0-6-0
Service.....	Switching

Flues, number and diameter.....	26—5½ in.
Length between tube sheets.....	15 ft.
Grate area.....	39 sq. ft.
Heating surfaces:	
Firebox and comb. chamber.....	144 sq. ft.
Tubes and flues.....	1,808 sq. ft.
Arch tubes.....	20 sq. ft.
Total evaporative.....	1,972 sq. ft.
Superheating.....	452 sq. ft.
Comb. evaporative and superheating.....	2,424 sq. ft.
General data estimated:	
Rated tractive force.....	45,000 lb.
Weight proportions:	
Weight on drivers ÷ tractive force.....	4.0
Total weight engine ÷ comb. heat. surface.....	74.2
Boiler proportions:	
Tractive force ÷ comb. heat. surface.....	18.55
Tractive force × dia. drivers ÷ comb. heat. surface.....	.947



Cross-section and elevation of the 0-6-0 type locomotives for the Seaboard Air Line

Cylinders, diameter and stroke.....	23 in. by 28 in.
Valve gear, type.....	Baker
Valves, piston type, size.....	12 in.
Maximum travel.....	8¾ in.
Outside lap.....	2½ in.
Exhaust clearance.....	¾ in.
Lead in full gear.....	¾ in.
Cut-off in full gear, per cent.....	65
Weights in working order:	
On drivers.....	180,000 lb.
Total engine.....	180,000 lb.
Total tender.....	165,300 lb.
Total engine and tender.....	345,300 lb.
Wheel bases:	
Driving.....	12 ft.
Total engine.....	12 ft.
Total engine and tender.....	52 ft. 1 in.
Wheels, diameter outside tires:	
Driving.....	51 in.
Journals, diameter and length:	
Driving.....	10 in. by 13 in.
Boiler:	
Type.....	Straight top
Steam pressure.....	205 lb.
Fuel, kind.....	Soft coal
Diameter, first ring, outside.....	70 in.
Firebox, length and width.....	78½ in. by 72 in.
Tubes, number and diameter.....	160—2 in.

Firebox heat. surface ÷ grate area.....	3.69
Firebox heat. surface, per cent of evap. heat. surface.....	7.29
Superheat. surface, per cent of evap. heat. surface.....	22.9

flanged. The driving wheel base has a total length of 12 ft., and the total wheel base for the engine and tender is 52 ft. 1 in.

The boiler has a wide firebox, 78½ in. long by 72 in. wide, with a grate area that is almost square in plan. A brick arch, supported on four tubes, is applied to the firebox. The superheater is a type "A," with 26 elements, and is designed for use in connection with a Chambers front end throttle.

The boiler accessories include two steam turrets, one supplying superheated and one saturated steam. The superheated turret draws its supply of steam from the left hand supply pipe in the smokebox and is tapped for the blower valve, dynamo valve, whistle and air com-

pressor, with provision for future application of a tender booster. The saturated steam turret is tapped for the injector steam valves, power reverse valve, coal sprinkler and ash pan flusher valves. Provision is also made for future connection of the air compressor to the saturated steam turret should it appear to be desirable.

The tenders have one-piece Commonwealth cast steel frames and the trucks are of the Vulcan cast steel side frame type. The side sheets are curved inward at the top to afford maximum clear vision for the engine crew. The coal and water capacities are 16 tons and 8,000 gal., respectively.

Gasoline rail car for Frisco

New Sykes 275-hp. mechanical drive car develops high tractive force in low gear

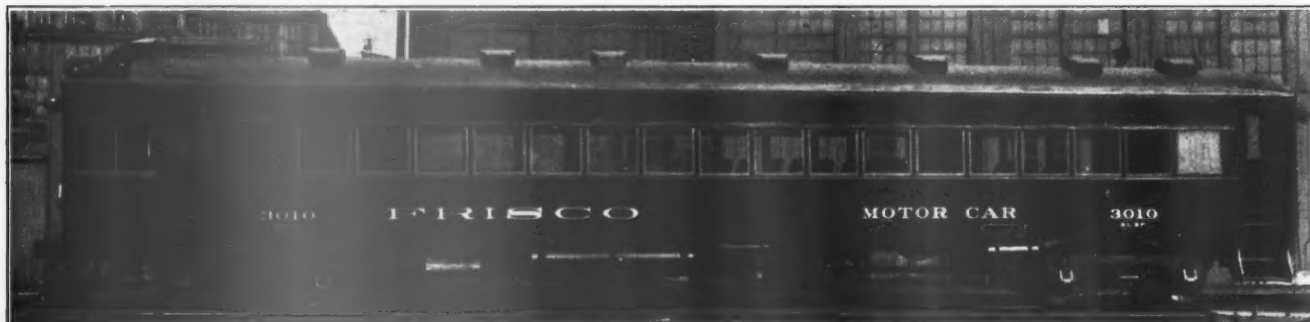
THE St. Louis-San Francisco has recently placed in service two mechanical drive gasoline rail cars of an improved design built by the Sykes Company, St. Louis, Mo., the car bodies being made by the St. Louis Car Company, St. Louis, Mo.

Each of these cars, having a light weight of 73,000 lb., length over bumpers of 62 ft. 3 in., and seating capacity of 62, is designed to develop a tractive force of 18,000 lb. in low gear, attain a speed of 60 miles an hour on straight, level track and pull a standard 50-ton coach on ordinary schedule runs at a gasoline consumption of 2 to 2½ miles per gallon. The engine holds six gallons of oil and operates an average of 1,600 miles per filling. An unusually high mechanical efficiency obtains,

ing nothing whatever to do with the actual shifting of gears except to select the gear ratio required and push a button.

A large tubular radiator covering half of the front of the car is used for cooling water, and a reserve tank of 30 gal. capacity is connected to the engine cooling system and mounted under a roof in the operator's cab.

The engine cooling system and the car heating system are connected together. In ordinary cool weather, when heat is required in the car, the cooling water from the engine is circulated through the heating pipes and heats the car. The temperature of the car can be regulated by by-passing more or less water from the car heating system to the engine cooling radiator.



The second of two Sykes cars recently delivered to the St. Louis-San Francisco

said to be 92 per cent from the engine to the rails in any of the three top gears.

The drive is by a Sterling coast guard 6-cylinder gasoline engine, with 6¼ in. bore and 7¾ in. stroke, developing 200 hp. at 1,200 r.p.m. and 300 hp. at 1,500 r.p.m., the latter being the governed speed. Dual intake and dual exhaust valves of overhead design are provided, also double cam shafts mounted above the cylinder head and operating directly upon the valve mechanism. The crankshaft, of heat treated alloy steel drilled for high pressure lubrication, is provided with seven bearings. Two independent electric starting motors assure reliability in starting, as the engine is too large for hand cranking.

Operating safeguards provided

Safety devices are incorporated to protect the engine against mistakes in operation. For instance, the starting circuit is so arranged that the engine cannot be started unless the spark is retarded and the ignition switch turned on. The change gear mechanism is operated by air, the actual control of the shifting operation being timed by a centrifugal governor and the operator hav-

While standing out over night at terminals in cold weather the car heater is kept running. The heater is then cut in with the engine and radiator and keeps the power plant system warm and ready to start in the morning. This is a safeguard against freezing and other injuries possible in starting a cold engine.

Engine noises muffled

The engine is mounted longitudinally in the car frame at the front end of the car, a housing being fitted around it to deaden the engine noises and deflect heat. Noises and heat from the usual type of inside mounted engines are minimized in this car.

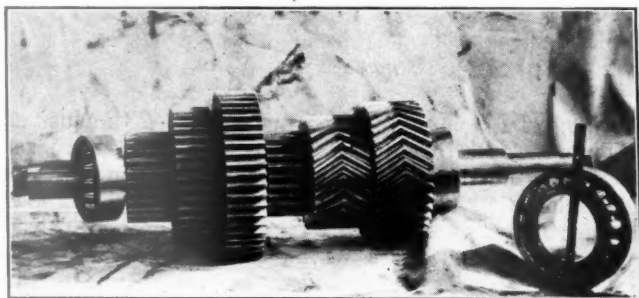
Fuel is fed to the two carburetors from the main fuel tank under the car by means of a vacuum system, operated from an oil vacuum pump mounted on the engine. The design is such as to enable one carburetor to draw the fire from the other. Excessive back firing through careless operation, or shortage of fuel, quickly closes the air inlets and while preventing fire escaping in the engine room, automatically stops the engine.

A 32-volt, 1-kw. electric lighting generator is directly driven from the transmission. It has ample capac-

ity to carry all the lights of the train, including the headlight, and is designed to keep the lighting batteries charged to capacity at all times. The generator cuts in at 300 r.p.m. of the engine, and generates current whenever the engine is running above that speed.

Trucks of standard four-wheel design

The trucks are of standard four-wheel design, equipped with plain bearings. On the inside axle is mounted



Transmission gears run in constant mesh— $4\frac{1}{2}$ -in. face herringbone gears used for the two high speeds—High capacity S. K. F. roller bearings employed

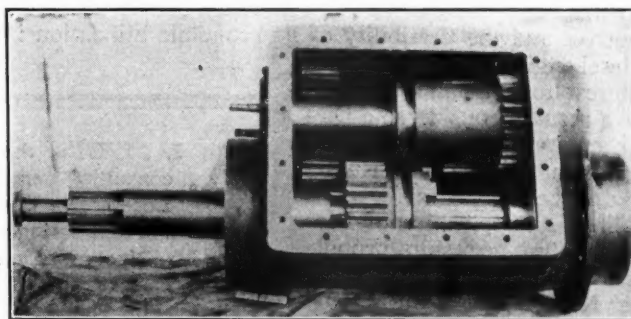
an unusually heavy set of spiral bevel driving gears made of alloy steel and heat treated. These gears are incased in a cast steel housing and mounted on Timken taper roller bearings. The drive is taken from the engine to the transmission by propeller shafts, and from the transmission at the center underneath the car by four-inch seamless steel tubular propeller shafts to both the front and the rear trucks. The universal joints run at virtually no angle under ordinary conditions, and are unusually heavy and sturdy.

The multiple plate clutch, of dry plate type, is self-contained, and has a capacity of approximately 200 per cent in excess of the duty required of it in the Sykes rail car. The clutch was designed by the Sykes Company especially for rail car service, and is provided with cooling fins and a two-minute adjustment.

roller type. Ample space is provided in the gear box for lubricating oil, adequate cooling of the oil being assured by the addition of cooling ribs on the box.

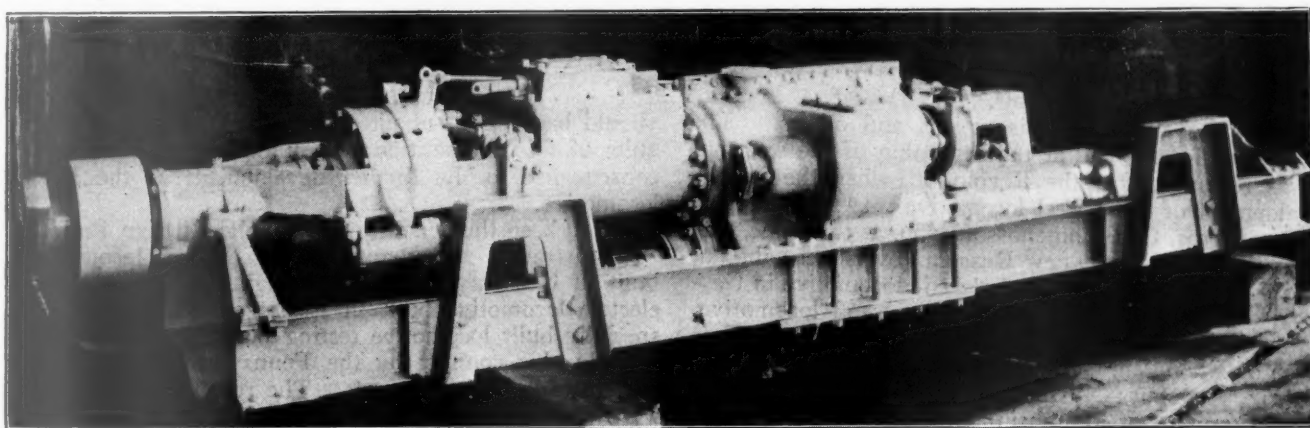
The centrifugal fly-weight governor for shifting is mounted at the rear end of the main gear box and driven directly from the transmission shafts. Shifting into and out of speeds is accomplished by air operating cylinders and pistons. The shifting cylinders give a positive length of stroke, insuring proper position at delivery. The actual operation of the air shift is analogous to manual operation, except for being more positive. It is designed to be instantaneous and always to engage the gears at a time when the engaging members are revolving at substantially the same speed.

The shifting is entirely selective, it being unnecessary for the operator to go through the gears progressively. He can shift the transmission into neutral position at any vehicle speed, and at will can pick up the speed of the



Speed changes effected by the Campbell patented wedge system-splined shafts are used at important power transmission points

train by engaging the proper gear reduction by pressing a button. If the car speed is either too high or too low for the gear ratio selected by the operator when picking up the speed from drifting, the gear will not engage until engaging members rotate at the same speed. All the operator is required to know is the approximate gear ratio corresponding to the car speed, and the selection of



View of the power transmission parts, which are mounted in a compact unit under the car

The gear change box gives six speed changes, a separate box attached to the main gear change box providing reverse in each speed. The low speed is extremely low, having a road speed of approximately four miles an hour at the maximum engine speed, and is used only for emergency starts with heavy loads, or for moving heavy loaded cars in and around yards. The gears are in constant mesh in the main gear box. Bearings throughout the transmission are of S. K. F. self-aligning

this ratio will permit gears to engage without clash or surge.

Westinghouse brake equipment for single end control motor cars in steam railroad service is provided, with a type DH-25, two-cylinder air compressor of 25 cu. ft. per minute capacity and two 16-in. by 60-in. storage reservoirs. Drop handle ratchet type hand brakes are installed, one on the platform at the rear of the coach and one near the driver's seat.

Diesel locomotive with gear transmission

Undergoes extensive plant and road tests—Develops rail tractive force of 39,600 lb.

By A. I. Lipetz

Consulting engineer, American Locomotive Company, Schenectady, N. Y.

THE Diesel engine has attracted serious attention in Russia since its first appearance in 1897, for the reason that oil is available in practically unlimited quantities in that country. Previous to that time oil was being used as fuel in stationary boilers and locomotives and the possibility of its economic utilization in Diesel engines became of great interest to Russian engineers. As a result a considerable Diesel engine industry was already in existence in Russia before the world war.

The first application of Diesel engines for ship propulsion was made in 1903 when the Nobel Works in Petrograd installed a Diesel engine in a Volga river boat. Since then many Diesel engines, both direct reversible and with electric transmission, have been applied to Russian boats and yachts. It is, therefore, only natural that the idea of the Diesel locomotive should have originated with the Russian railroads. This started in 1906-1908 and continued until the outbreak of the war in 1914. Various designs were worked out and much experimental work was done by Professor Grinevetski, Yadoff, Schelest, the author of this article, and others.¹ The work was discontinued at the beginning of the war, but it was resumed after the Revolution, when the further development of the Diesel locomotive was placed in the hands of Prof. Geo. Lomonosoff who, at that time, was chosen to represent the new Russian government abroad. He ordered a 1,000-hp. Diesel-electric locomotive in Germany known at present as the Lomonosoff locomotive. It was designed and built by the Maschinenfabrik Esslingen of Esslingen, Germany, jointly with the Maschinenfabrik Augsburg-Nürnberg (M.A.N.) and Brown-Boveri Company of Mannheim, Germany. This locomotive was described in the March, 1925, *Railway Mechanical Engineer*. Later, a second locomotive of the same power with magnetically operated friction clutches and gear transmission was ordered from the Hohenzollern Locomotive Works of Duesseldorf, Germany. The design of the locomotive was worked out by this company, jointly with the Friedrich Krupp Works of Essen and the Eisenach Magnet Werk of Eisenach, Germany, under the supervision of N. A. Dobrovolsky. This locomotive was described in the July, 1926, *Railway*

Mechanical Engineer, pages from 425 to 428 inclusive.²

Thus the idea of a direct transmission with interposed pneumatic clutches incorporated in the early designs of Diesel locomotives was revived, although in a modified form, namely, the clutches were made magnetic instead of pneumatic and gears with different ratios were included in the transmission.

These two Diesel locomotives, together with a third locomotive built in Russia according to Professor Hackel's design,³ are the only road locomotives so far in existence with an output in the neighborhood of 1,000 hp. The question of Diesel locomotives is considered in Russia as a very vital problem of railroad operation, and new experimental locomotives are now in contemplation. A special Diesel locomotive committee for the purpose of designing and inviting designs for Diesel locomotives has been organized as a part of the engineering department of the Railroad Administration in Moscow. Moreover, a universal competition with prizes for designs was announced two years ago, for which projects of Diesel locomotives of a specified power

should have been submitted by May 1, 1927. The results of this competition will, undoubtedly, be of great consequence to the further development of the Diesel locomotive.

It has been the general policy of the Russian Railroad Administration to submit the two Diesel locomotives built in Germany to very thorough tests. The Diesel electric locomotive built in Esslingen was tested on a specially built locomotive testing plant, similar to those used in this country by the Pennsylvania at Altoona, Pa., Purdue University, etc. The results of these tests were published in a book by Professor Lomonosoff.⁴ The testing plant was later moved to the Hohenzollern Locomotive Works where the second Diesel-g geared locomotive was nearing completion. The locomotive was tested on the plant, and afterwards it was also tried with trains on German roads before its shipment to Russia. A comprehensive description of the locomotive with results of the tests both on the testing plant and on the German Railroads was recently published by N. A.

¹ Die Diesel-Elektrische Lokomotive, by Prof. G. Lomonosoff, Berlin, 1924, pp. 16-22.

² See also Diesel Locomotives for Main Line Traffic, the Railway Engineer, October, 1926, pp. 357-363.

³ Oil Engine Power, August, 1926, pp. 490-497.

⁴ Thermolocomotive U 001 and its Testing in Germany (in Russian), Berlin, 1925.

Dobrovolsky,⁵ who was in charge of the design and conducted the tests with the locomotive.

Diesel locomotive with gear transmission

The most interesting results of the tests and the conclusions drawn by N. A. Dobrovolsky are given below. As the description of the Diesel-gear locomotive has been already published in the July, 1926, issue of the *Railway Mechanical Engineer*, very little need be said about the design of the locomotive. However, it would not be amiss to say a few words about some of the most interesting parts. The main magnetic clutch connects and disconnects at will the gear transmission, the locomotive jack shaft and the driving wheels to and from the Diesel engine. The body of the clutch is extended so as to incorporate in it a flywheel, and special radial air gaps are provided between the flywheel and the friction plate of the clutch to facilitate the dissipation of heat generated when the clutch is in action. The winding of the magnetic coils is made so as to insure high magnetic action with a very small absorption of power. The current is controlled by a resistance, and a very gradual and smooth engagement takes place during the

Speed stages are controlled by separate magnetic clutches

The three-speed stages are controlled by three high powered magnetic clutches, one for each stage. The object of these multiple-disc clutches is different from that of the main magnetic clutch. This will be obvious from the consideration of the method of starting and changing the speeds of the locomotive. Starting proceeds as follows: the main magnetic clutch is disengaged, the first speed multiple-disc clutch is thrown in, so that its friction surfaces come in contact and are pressed against each other. The oil engine is running idly at a speed about one-half that of normal. The main magnetic clutch is gradually engaged by passing current through its coil; at the same time the mean effective pressure of the oil engine is raised by admitting more fuel into the cylinders. Up to a certain amount of current slippage takes place between the friction surfaces of the main magnetic clutch; at a certain moment engagement begins to take place, possibly alternating with slippage, and the locomotive starts. As acceleration continues, the slippage gradually decreases and at a certain speed, about 4 m.p.h., engagement completely takes place. The further increase of the locomotive speed is obtained by increasing the number of revolutions of the oil engine to normal. Thus at starting no slippage whatsoever takes place in the multiple-disc (speed) clutch; as regards the main magnetic clutch a certain slippage corresponding to an absorption of approximately one-half of the energy developed by the oil engine during the acceleration period, does take place between the friction surfaces. Tests have shown that this period of acceleration is very short, this on account of the low speed at which full engagement is obtained. The wear of the friction lining is, therefore, very small.

If a further increase in speed is required, the main magnetic clutch, as well as the first speed clutch, are disengaged, and the second speed clutch is thrown in. As the inertia of the gear transmission parts is comparatively small, very little slippage can take place in the speed clutch. The speed of the oil engine, after it has been disconnected, is reduced to approximately one-half of its normal speed, and as the locomotive is moving at approximately the former speed, the angular velocities of the friction surfaces of the main magnetic clutch are almost equal. At this moment the main magnetic clutch is again engaged with practically very little slippage. The speed of the locomotive is afterwards increased by speeding up the oil engine to its normal number of revolutions. The third speed is obtained in the same manner by changing from the second to the third gear.

The reduction in speed when an increase in tractive force is required goes on in the opposite direction, namely, the locomotive is slowed down by decreasing the speed of the oil engine, and the main magnetic clutch with the speed clutch which has been in operation are disengaged; the new speed clutch is then thrown in, and the speed of the oil engine is raised to the point when the main magnetic clutch can be again switched in without jerks, or slippage.

Thus it will be seen that if the operation of the locomotive is followed strictly as explained in the preceding paragraph, there should be very little slippage in the multiple-disc (speed) clutches, and that in the main magnetic clutch slippages will take place only during the acceleration period at starting. For this reason the speed clutches could be made of the multiple-disc type and of very compact design, as practically no heat is generated in a speed clutch and no heat dissipation is required, whereas the main magnetic clutch must be of

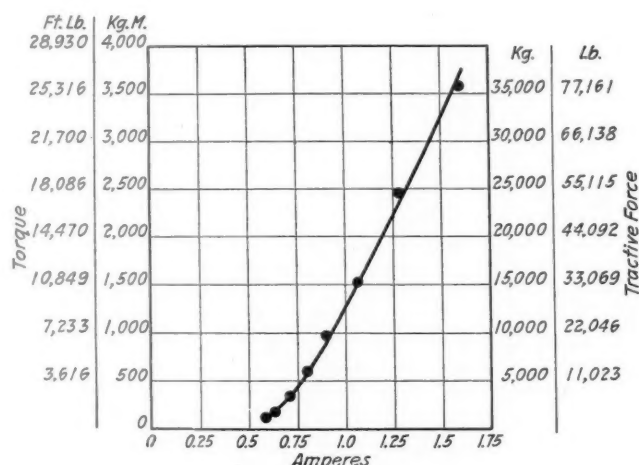


Fig. 1—Chart showing the relation of the torque or tractive force capacity of the main clutch to the current passing through the coils of the clutch magnet

acceleration period. The relation between the torque (or the tractive force) and the current in amperes is shown in Fig. 1.

The gear transmission, which is also described in the July, 1926, *Railway Mechanical Engineer*, page 427, consists principally of three pairs of gears always in mesh with three friction clutches operated magnetically. The ratio for the first gear is 6.923, for the second 3.966 and for the third 2.053, or, roughly speaking, 1:7, 1:4 and 1:2. At a speed of 360 r.p.m. of the Diesel engine, the corresponding speeds of the locomotive are 8.0, 14.0 and 27.1 m.p.h., the diameter of the driving wheels being 52 in. Variation within certain ranges below and above these speeds can be obtained by decreasing or increasing the speed of the Diesel engine. The latter, however, has a critical speed between 410 and 430 r.p.m.; therefore, the speed of the engine is seldom raised above 400 r.p.m. and the speed of the locomotive can hardly be more than 30 m.p.h. By very skillful operation the Diesel engine can be sped up to 450 r.p.m. with quick passing through the range of critical speeds, but this cannot be done under load when the main clutch and the gear are in engagement.

⁵ Thermolocomotive U 005 and its Testing in Germany (in Russian), Moscow, 1927.

such a design as to provide large air exposed surfaces for heat dissipation.

In order to make the described manipulations of speed control possible, a tachometer with three scales on the dial, is placed in the engine cab. The outer scale shows the number of revolutions of the oil engine, whereas the remaining three scales indicate corresponding speeds in kilometers per hour for the first, second and third gear ratios. A separate speed indicator shows the speed at which the locomotive is travelling. The main magnetic clutch must be thrown in at the moment when the dial hand of the tachometer indicates a gear speed equal to that shown by the speed indicator.

Plant tests of the Diesel-gear locomotive

The Diesel-gear locomotive was tested last year on a testing plant at various speeds, gear ratios and oil-

5 to 2.15 grams, and notch 6 to 2.70 grams. At zero position fuel enough for the idle running of the oil engine was admitted, whereas position 7 represented overload. Tests were not made for each of the positions 0, 1 and 7.

Each test was conducted at constant conditions of running and the following observations made during each test:

- 1—The speed of the oil engine.
- 2—The speed of the locomotive.
- 3—The drawbar pull measured by the dynamometer of the testing plant.
- 4—The consumption of fuel of the main oil engine for a certain period of time.
- 5—The consumption of fuel by the auxiliary Diesel engine.
- 6—Incoming and outgoing temperatures of the cooling water and oil used for piston cooling of the oil engine.
- 7—Amounts of the cooling water and oil.
- 8—Indicator cards were taken.

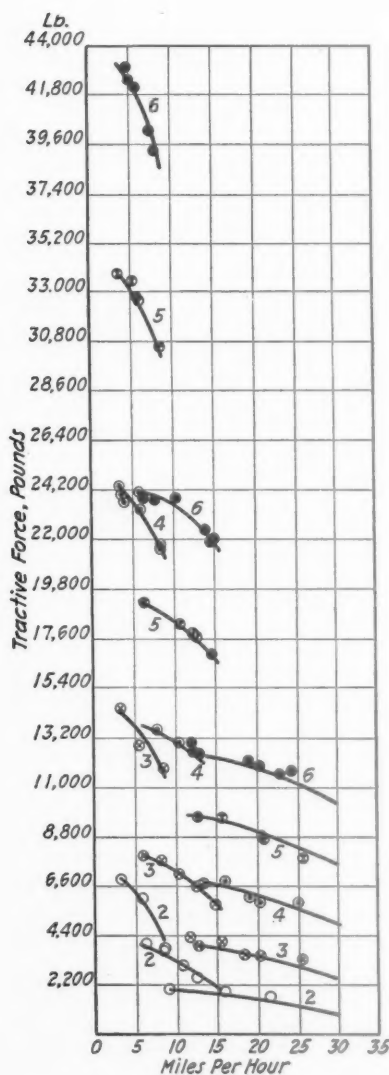


Fig. 2—Tractive force for five positions of the fuel pump and for three gear ratios

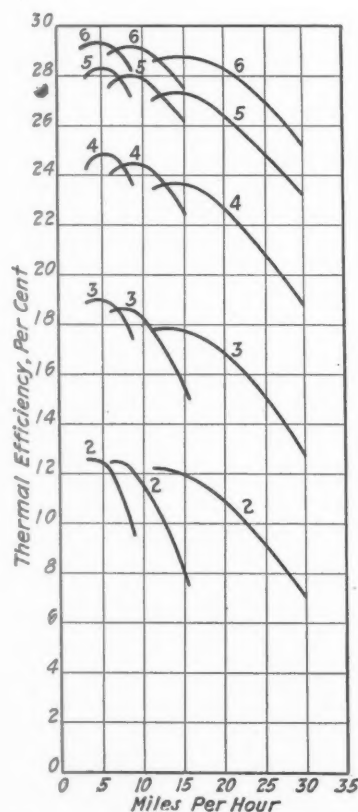


Fig. 3—Overall thermal efficiency at five positions of the fuel pump and three gear ratios

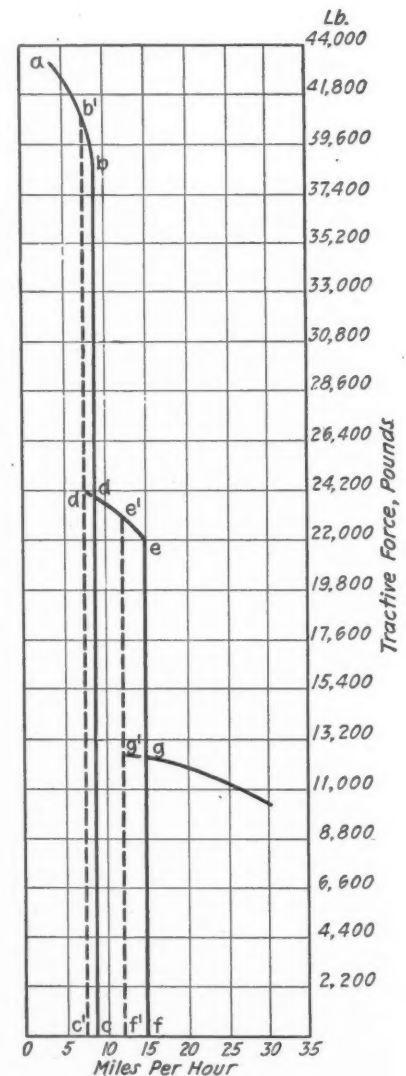


Fig. 4—Tractive force plotted for the normal output of the oil engine

engine load factors (mean effective pressures). The variation of the latter was obtained by varying the admission of fuel. The following procedure was adopted:

The fuel pump was calibrated and several positions, or "notches" were marked, each notch representing admission of a definite quantity of fuel. Notch 2 corresponded to .80 grams of fuel oil per stroke per cylinder, notch 3 to 1.25 grams, notch 4 to 1.70 grams, notch

5 to 2.15 grams, and notch 6 to 2.70 grams. At zero position fuel enough for the idle running of the oil engine was admitted, whereas position 7 represented overload. Tests were not made for each of the positions 0, 1 and 7.

The duration of each test was such as to permit a consumption of fuel of not less than 160 lb.—this for the reason that the inaccuracy of the fuel consumption reading should not amount to more than a few per cent of the total figure.

Fig. 2 shows the rail tractive forces in pounds plotted against speeds in miles per hour for the five above mentioned notches, and for three gear ratios of the loco-

motive; altogether 15 curves. The circles on the chart correspond to values actually obtained from tests.

For the calculation of the total fuel consumption of the main and auxiliary Diesel engine, it was assumed that the auxiliary Diesel engine had a constant consumption of 22.05 lb. per hour. This was determined by a special test for the most unfavorable conditions in summer, when the cooler fans are absorbing much power. On the basis of the fuel consumption the overall thermal efficiency of the locomotive was estimated and plotted (Fig. 3) for the five notches and three gear ra-

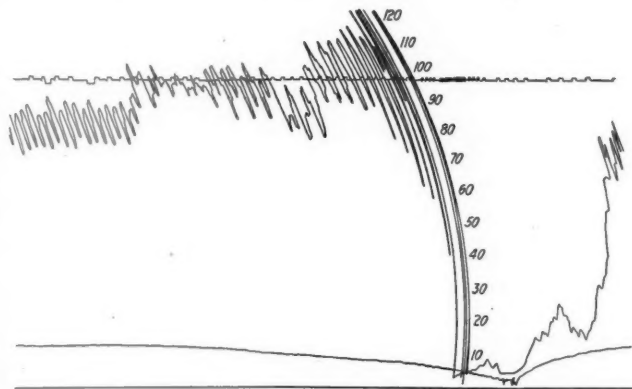


Fig. 5—Dynamometer chart showing the actual drawbar pull starting a 1,180-ton train on a 1.1 per cent grade

tios. It will be observed that the full load thermal efficiency approached a record figure of 29.3 per cent. This is due to the very high mechanical efficiency of the transmission, which at full load and full speed was reaching 96 per cent. For full load and lower speeds, the mechanical efficiency fluctuated between this latter figure and 88 per cent. At half load it was between 85 and 94 per cent, and at quarter load it varied between 72 and 90 per cent.

Fig. 4 shows the rail tractive force chart as a function of speed for the notch 6, which represents the normal output of the oil engine. The dotted lines indicate the speed at which the efficiency curves cross each other and above which a higher notch should not be used.

Mr. Dobrovolsky calls attention in his pamphlet to the fact that the tractive force lines must be dropped down to the zero line and that the tractive force follows the curve *a b c d e f g h*, because the tractive force drops to zero every time the gear is changed. It is erroneous, in his opinion, to draw the curve as a continuous step line, because there is no continuity of tractive force between the three regions of speeds.

The Diesel locomotive has been designed so as to correspond in power and tractive force to a standard Russian 0-10-0 locomotive with cylinders 25 in. by 27½ in., 185 lb. pressure, and weighing 176,000 lb. on the drivers. The 4-10-2 Diesel locomotive has a total weight of 288,800 lb. of which 194,000 lb. is on the drivers. The maximum rail tractive force which the Diesel locomotive can consistently develop proved to be equal to 39,600 lb., which is 15 per cent higher than the corresponding tractive force of the 0-10-0 steam locomotive, calculated to the Russian formula. Thus the Diesel locomotive can pull 15 per cent heavier trains than the steam locomotive. However, the corresponding speeds are from 20 to 35 per cent lower than those of the oil-burning steam locomotive.

Although the tests made on the test plant were of great value, they did not give any indication as to the performance of the locomotive in actual service, especially to the operation of the gears and clutches. Be-

sides, the manipulations necessary for starting and changing speeds required special skill which could not be demonstrated on the test plant. In addition, it was of considerable interest to check the data obtained on the test plant by running actual trains. These were the reasons why it was decided before shipping the locomotive to Russia, to test it with trains on roads in Germany. Thus the locomotive was first broken in on the line between Duesseldorf and Opladen. On May 6, 1926, the locomotive, driven by Mr. Dobrovolsky, pulled a train of 794 tons on a .7 per cent grade. This was successfully performed and on the next day a train of 1,180 tons was pulled over the same district. The train was stopped on the .7 per cent grade and again started, in order to prove the suitability of the locomotive for starting and accelerating trains on grades. The locomotive was later sent to Berlin and 21 trips were made on a special division where German steam locomotives are usually tested—the Güsten-Sandersleben-Hettstedt-Mansfeld Division, which has very long 1 per cent grades and a continuous grade of 1.1 per cent, 8.7 miles long. This permitted making tests at constant conditions similar to those on the test plant.

A dynamometer car of the German State Railways was attached to the locomotive, and the following appliances and observations were added to those previously enumerated:

- 1—The indicators on the Diesel engines were equipped with a centralized electric control for taking simultaneous indicator cards.
- 2—Small graduation tanks for fuel were installed which permitted taking readings with the accuracy of .1321 gal.
- 3—The exhaust-gas temperatures were measured by pyrometers with readings in the dynamometer car.
- 4—Exhaust-gas analyses were made in the dynamometer car into which special samples of gas were pumped from the exhaust passages.

The train was composed of cars with coal of a previously determined standard weight per car, which were at the disposal of the experimenters during the whole

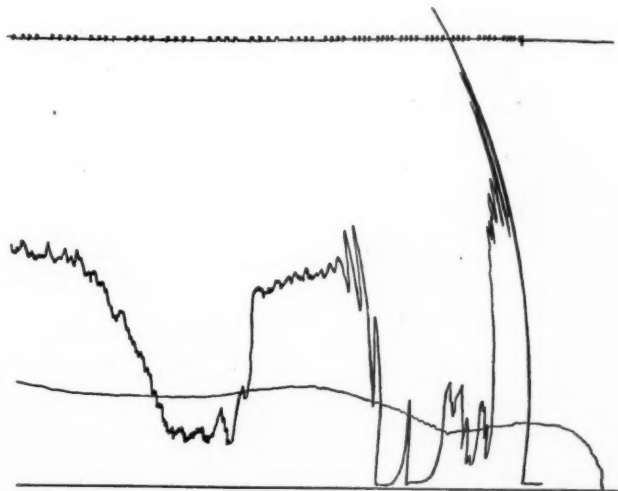


Fig. 6—Variation in tractive force at changing the speed from the first to the second

period of tests, from May 25 to May 29, 1926. The results of the tests were plotted on new curves which checked very well with those obtained at the test plant.⁷ The fuel consumption was also in strict agreement with the figures formerly obtained.

Figs. 5 and 6 are portions of dynamometer charts showing actual drawbar pull. Fig. 5 corresponds to starting a 1,180 ton train on a 1.1 per cent grade. It

⁷ Mr. Dobrovolsky shows in his pamphlet the new curves in order to prove that they actually coincide with the former charts—they are omitted here for lack of space.

indicates that the drawbar pull at starting was over 20 metric tons (44,000 lb.) and that later, when the conditions became stabilized, the tractive force dropped to 17 metric tons (37,500 lb.). Fig. 6 shows the variation in tractive force, at changing the speed from the first to the second.

During the tests several defects in the locomotive design and construction were discovered which later were eliminated by the Hohenzollern Locomotive Works in Duesseldorf, where the locomotive was returned. It was found that the jack shaft cranks were not set under proper pressure. The multiple-disc magnetic clutches sometimes ran hot when the air gap was not properly kept up. The gears did not show any appreciable wear, and Mr. Dobrovolsky is of the opinion that if proper care is taken the gears can run for several years without any maintenance.

It was also found that the auxiliary Diesel engine is of very little value and that the auxiliaries can be driven

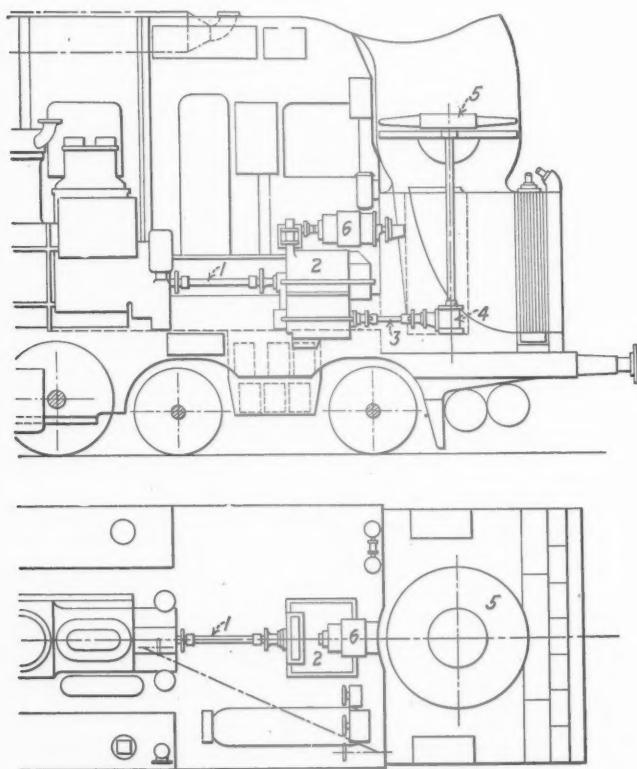


Fig. 7—New arrangement of drive for the fans and generator

to better advantage from the main engine. The drive to the auxiliaries was, therefore, changed from that shown on Fig. 2, page 426, July, 1926, issue of the *Railway Mechanical Engineer* to the arrangement in which the fans and the generator for the magnetic clutches and lighting purposes were coupled directly to the main engine by means of gears and shafts, as shown in Fig. 7.

Conclusions

Mr. Dobrovolsky's conclusions which he draws from the test results are of great interest. In addition to the high efficiency mentioned above, he accentuates that the Diesel-gear locomotive is the lightest Diesel locomotive in existence. If the weight of the Russian 0-10-0 steam locomotive with its tender is taken as 100, the weight of a comparable Diesel locomotive with electric transmission is between 174 and 197, and that of the oil-gear locomotive is only 133. He further thinks that by using a Diesel engine of a lighter design, the weight

of the Diesel locomotive can be reduced to that of the steam locomotive. While that might be true if a reliable high-speed light Diesel engine could be found on the market, it is doubtful, however, whether the other conclusion of Mr. Dobrovolsky as to the cost of the Diesel locomotive is correct. He thinks that if the weight of the locomotive will be reduced, the price of a Diesel-gear locomotive will not differ substantially from that of a steam locomotive. He overlooks the fact that prices of a high-speed light-weight Diesel engine go up in proportion to the reduction in weight, as special steel castings, aluminum and other alloys have to be used and much more refinement in design and workmanship is required. It seems that the price of a Diesel engine is more likely to remain constant in relation to its power than to its weight, and no reduction in price should be expected from lightening the Diesel locomotive. Moreover, the price of the gear transmission cannot be compared with that of any machined part used on a steam locomotive; nor can the auxiliaries and other parts of a Diesel locomotive be placed in line with a boiler or a tender of a steam locomotive as regards cost.

The maintenance of the Diesel engine with gear transmission and clutches, and the depreciation of these machines will also be higher than in a steam locomotive. Mr. Dobrovolsky thinks that the gears will not need repairs for years. This might be true, but when the need of repairs comes, the gears will have to be replaced by new ones made of special alloy steel and manufactured by the special process described above. This cost of renewal will, undoubtedly, be very high.

Mr. Dobrovolsky further accentuates the increase in tractive force for starting, but he overlooks the fact of the drop in speed, and that for road service the Diesel locomotive must be equal in power, not only in maximum tractive force, to that of the steam locomotive, if the same speeds for trains of the same weights are expected.

There remains, however, the great advantage of fuel economy resulting from the high thermal efficiency of the Diesel-gear locomotive which attains an unheard of figure of 29.3 per cent—almost four times as high as the thermal efficiency of the best steam locomotive. It must not be forgotten, however, that as Fig. 3 shows, this efficiency is only obtained at full load and low speeds, and that with the drop in the load factor the efficiency of the oil engine drops very rapidly. On the second notch the efficiency varies from 8 per cent to 12 per cent, which is only slightly better than in ordinary locomotives. The question is, therefore, how often the Diesel locomotive will have to run at load factors below 100 per cent. It is very likely that most of the time the full power will be utilized, but it is also probable that on a level track even with full tonnage trains determined by the ruling grade, the locomotive may have to use fuel admissions corresponding to the third, fourth and fifth notches with efficiencies dropping sometimes to 16-18 per cent. Only data from actual service can enlighten us on this point and give us information as to how often the 29.3 per cent efficiency figure will be made use of.

Mr. Dobrovolsky admits that the discontinuity of tractive force and its drop to zero at the time of changing speeds is a great disadvantage. The selection of the moment of engaging the main magnetic clutch, after the necessary change in speed clutches has been made, requires great skill from the operator, as when the oil engine is cut off from the driving wheels, the change in speed of the coasting locomotive depends upon the profile of the road. In addition to that the full power of the oil engine is utilized only at speeds corresponding to the full speed of the Diesel engine, theoretically speaking

only at three speeds in the present locomotives. At intermediate speeds, which are obtained by controlling the speed of the oil engine, the Diesel engine does not develop its full power.

Neither does Mr. Dobrovolsky think that the three speeds were correctly chosen. In his opinion a Diesel locomotive with gear transmission must have four speeds, of which the first should serve only for starting and acceleration of the train and the three other speeds

should be chosen in accordance with the requirements of traffic.

After the tests had been completed and all the necessary changes made, the Dobrovolsky locomotive was sent to Russia under its own power. Last March it was demonstrated in Riga, Latvia, and crossed the Russian border. It has since been placed in service and it is to be expected that the experience which will be gained will be of importance in the development of Diesel locomotives.

Layout of apparatus on Virginian electric locomotives

By C. C. Whittaker

Railway equipment engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

WHEN a locomotive is to be built which shall have a maximum power output for minimum weight, the designer is at once confronted by a number of problems which must be solved by compromise. Heavy pieces of equipment must be located near the center of the locomotive and equally disposed about the center lines in order to minimize undesirable oscillations, either rolling or swinging, commonly called "dumb-bell" effect. Current collectors must be located so as to minimize the effect of side displacement on curves. The equipment must be arranged so that the minimum length of cab results and hence a minimum

the buffing strains and contains the traction motor rotor and jack-shaft bearings. The supports for the electrical equipment and the cab housing this equipment are built directly on this casting. The effect of this form of design on the electrical control apparatus had not been proved previously by service, as former designs had the electrical apparatus mounted in a cab which was in effect spring borne. The effect of this present design is to give a massive bedplate on which the electrical equipment is supported.

This large mass is not as subject to vibrations due to inequalities of the roadbed, etc., as were previous less

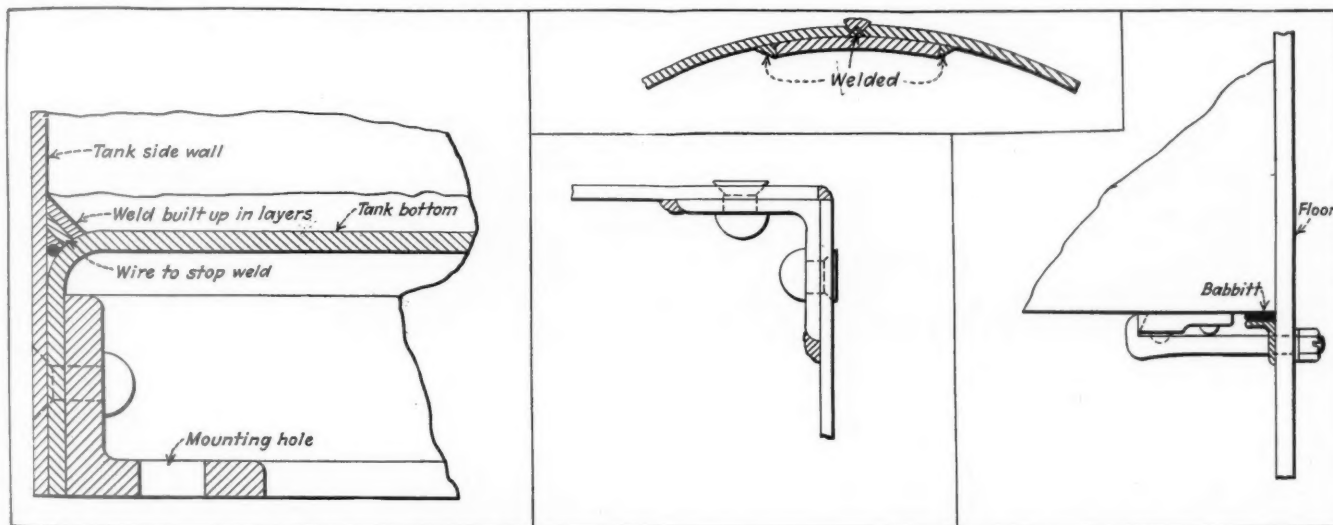


Fig. 1—Top center—Section of triple welded vertical seam of transformer tank—Left—Method of riveting and welding bottom of transformer tank to the sides—Bottom center—Inside corners of liquid rheostat are reinforced by angles riveted and triple welded—Right—Method of fastening the liquid rheostat tank to the floor of the motive power unit

length of cable runs and pipe. High tension apparatus, where possible, should be enclosed in a grounded compartment as a safety measure. A minimum amount of inflammable material should be used and the cable should be protected either by a flame-proof braid, conduit or ducts.

All equipment must be installed so as to offer the maximum facility for inspection, maintenance and removal for heavy repairs without greatly disturbing adjacent parts.

The Virginian locomotives were designed with a rigid frame or backbone steel casting which transmits all of

heavy structures. It does, however, take a greater share of the buffing impact inasmuch as the bump is transmitted directly to the backbone frame or apparatus support. Previous designs with separate trucks and the cab mounted thereon by center pins, have the buffing strains transmitted to the equipment in a less direct and more resilient path.

This means that the liability to fail is transferred from a more or less continuous source of vibration to an infrequent but more severe source. Realizing this, special care was taken in fastening the heavy pieces of apparatus to the locomotive frame to resist both the

shear of their support and the tendency to overturn when maximum butting strains are encountered.

The heaviest single piece of apparatus—the phase converter, weighing 30,832 lb.—is held down by 12 $1\frac{1}{2}$ -in. bolts through $1\frac{9}{16}$ -in. holes and in addition is keyed against a longitudinal displacement by being wedged within a depressed portion of the locomotive frame casting.

The second largest piece, the main transformer weighing 25,000 lb., offered a new problem inasmuch as it is an oil-insulated, forced-cooled type. As hot oil is extremely difficult to hold by any usual form of riveted or calked joint, it was decided to build the transformer tank as a cylinder with one triple-welded, vertical seam, Fig. 1, top center, and with the bottom flanged, riveted and welded to the sides, Fig. 1, left. In addition, the bottom is reinforced by I-beams on which the weight of the transformer proper is carried.

This cylindrical structure when fastened securely at

tank rests on the floor of the cab surrounded by an angle frame riveted to the floor. The space between this angle frame and the rheostat tank is filled with babbitt. The tank is held down by J-bolts at each end, Fig. 1, right. Flexible cable is employed for leads to the rheostat.

Since these motive power units may operate singly, or in groups of three or four, special attention was given to the operation of the pantographs, from the standpoint of safety, Fig. 2. When operating two or three cabs in multiple, a bus line extends the full length of the complete locomotive. This bus line is energized whenever any one pantograph is against the trolley wire. Consequently, if it becomes necessary for a man to go onto the locomotive roof, his first act before ascending is to lower all pantographs and then to throw in the bus line grounding switch. This feature protects the attendant while on the roof from the accidental release of any pantograph. If for any reason a pantograph should become disabled it can be conveniently disconnected from

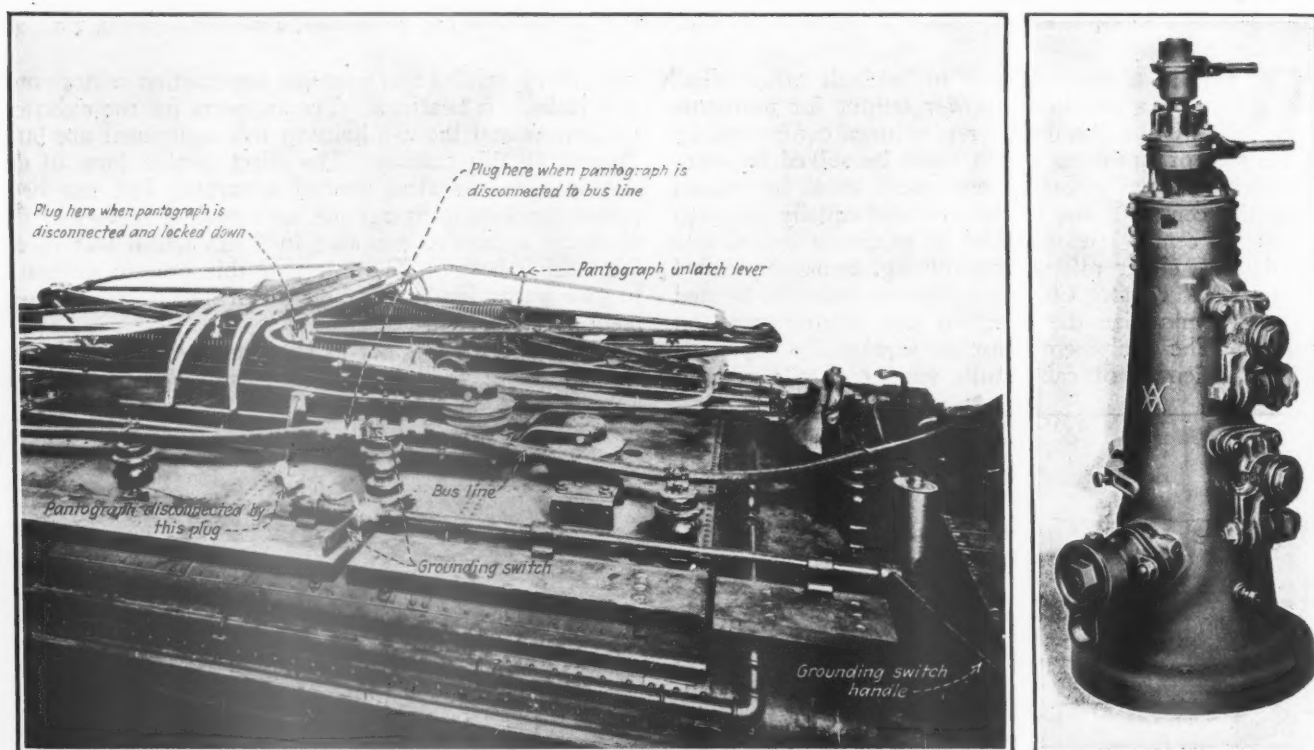


Fig. 2—The Virginian pantograph includes some special features—Right—The K-14-A brake valve pedestal used on the Virginian motive power units

the base has sufficient rigidity to withstand the shocks met in service, notwithstanding the high center of gravity of the complete transformer. It is held down by eight $1\frac{1}{4}$ -in. bolts through $1\frac{5}{16}$ -in. holes and is further wedged between fitted lugs against longitudinal displacement.

The transformer projects through the roof and has a removable top for inspection. All leads, both high and low tension, are taken through special insulating bushings in the tank side and are properly shielded from the weather. Where the low tension copper strap leads, cleated to the cab structure, are joined to the transformer terminals, flexible copper braid leads are interposed to accommodate any slight motion which may exist between the cab shell and the transformer tank.

The third heaviest piece of apparatus—the liquid rheostat, weighing 21,900 lb. complete—has a relatively large base and a low center of gravity. Its tank is rectangular with corners reinforced by inside angles riveted and triple-welded, Fig. 1, bottom center. The whole

the bus line and locked down by means of the same plug and flexible cable which is used to connect the pantograph to the bus line. When in case of an emergency a pantograph must be unlatched or pulled down from a position on the ground, a 15-ft. impregnated wood hook stick is provided. This stick is normally carried in a length of conduit on the side of the locomotive and is thus always dry.

The air brake piping at the engineman's stand was greatly simplified by the development of the K-14-A brake valve pedestal bracket, Fig. 2, right. Ducts were cast in the walls of the pedestal to take the place of pipes which on other equipments connected to the brake valve, to feed and reducing valves, brake pipe cutout cock, equalizing reservoir and other details. The space within the pedestal became the equalizing reservoir. By means of this pedestal construction a large amount of difficult and unsightly pipe fitting was made unnecessary, eliminating in all approximately 40 threaded connections.



Wood finishing—a glance ahead*

Considered as an art, a science and a branch of engineering
—Need for methods of measuring the service
value of finishes

By F. L. Browne

Chemist, United States Forest Products Laboratory, Madison, Wis.

WOOD finishing is at once an art, a craft, and a branch of engineering. It will always require skilled workmanship, esthetic appreciation, and technical knowledge. In the easy-going times when small manufacturing establishments were the order of the day, it was possible for the craftsman to assume the entire responsibility; but as the woodworking industries became more complex and more highly specialized the traditional policy of leaving it all to the finisher has been productive of more and more worry for the executive, until at the present time in many lines the finishing room probably gives rise to more exasperating difficulties than any other division of the operations. In looking for ways of improving the situation it is important to keep in mind that the problem has three sides, and that new developments on the technical side have an important bearing on the other two.

There are those who feel that the art of wood finishing has been even more seriously neglected than its technology, and that the tendency in recent years has been away from rather than in the direction of a better balance between these two aspects of the subject. At least two factors probably have tended to discourage artistic originality in wood finishing—the dominance of manufacturing considerations over esthetic values, and the craftsman's monopoly of finishing knowledge.

The importance of the second factor tending to discourage artistic originality in wood finishing is manifest. Since the craftsman is concerned primarily with the routine of production, he naturally tends toward standardizing his work with as few materials and operations as possible, and opposing the introduction of new effects and new technic. For obvious reasons he is likely to take

sides with the engineer against the designer in the conflict between convenient production and artistic expression. When he alone possesses the knowledge of what can be done in the way of finishing and how to do it, as has been the case all too frequently in the woodworking industries, the designer's efforts are very narrowly circumscribed.

Wood finishing as a craft

The wood-finishing craftsman has been traditionally jealous of the intrusion of the uninitiated, especially the engineer and chemist, into his secrets, and the technical man in return has continually increased the complexity of the subject by perforce introducing new materials, new methods of application, and even new woods, each departure from the good old-fashioned way bringing with it a whole new set of special precautions to be learned if disaster is to be avoided. Unfortunately, that rivalry has resulted in placing altogether too much emphasis upon cook-book formulas of magic concoctions.

The craftsman's place in wood finishing is assured not by the secret formulas which he thinks he possesses but by his mastery of the materials with which he works. Technical progress has a way of making more rather than less demand upon his ability. It is more difficult to apply smooth, uniform coats by means of the spray gun than with the brush, and the care and operation of the new tool are more intricate. Nitrocellulose lacquers are even more capricious than varnish, and require closer attention to avoid getting into trouble. Not only are the newer materials and methods increasingly complex, but their very multitude in itself adds to the craftsman's burden by making it necessary for him to familiarize himself with the peculiarities of many different products. A generation ago the finisher needed to understand the

*Abstract of paper presented by the Wood Industries Division at the annual meeting, December 6 to 9, 1926, of the American Society of Mechanical Engineers.

use of a few dozen materials, whereas today he must be able to handle several score.

While the demands upon the craftsman have been growing more exacting, social forces too familiar to need mention here have combined to make it more difficult for industry to obtain skilful wood finishers in sufficient numbers. Much attention has been paid to the problem of finding a satisfactory substitute for the obsolete apprenticeship system, and thus far without much success. Whatever the answer to this question may be, it is sufficient for present purposes to recognize that the training of craftsmen is a major portion of the wood-finishing problem which is not likely to be solved by developments of a purely technical nature but on the contrary may be rendered more acute.

Wood finishing as a branch of engineering

Although the engineer is not the only expert whose special talents will be required to solve the wood-finishing problem, there can be no question that he must be called upon for an exceedingly important contribution.

It so happens that the technical man whose attention is drawn to wood finishing is very likely to approach the subject from the direction of the paint and varnish industries rather than from the side of the woodworker, and therefore to look upon wood finishing as a branch of paint science. As a matter of fact, wood-finishing engineering should have its foundation in wood science rather than in paint science. Complicated and imperfectly understood as our finishing materials are, the wood is still more complex and even less understood. Troubles in wood finishing probably arise far more often as a result of the peculiarities of wood than of those of the finishing materials. The characteristics of wood can be controlled only within very narrow limits, and as timber supplies become less abundant it is more difficult to choose woods for their ease of finishing alone. The finishing materials, on the other hand, are nearly all manufactured products or could be replaced by manufactured products, and therefore can be altered more nearly at will to suit conditions imposed by the wood. The ideal in wood finishing, therefore, is most likely to be achieved when we start with a thorough knowledge of wood properties and select materials and methods in conformity with them rather than by trying to modify wood properties to suit finishing methods.

If wood science is the foundation of wood-finishing engineering, then the latter is surely in its infancy. Even such an apparently simple question as "how does moisture escape from a piece of wood during drying?" cannot be answered satisfactorily at the present time. Until we are in a frame of mind to answer such questions less glibly and more thoughtfully than at present, it will be inopportune to try to explain such interesting facts of wood finishing as:

1—The effectiveness of shellac as an undercoat in comparison with other spirit varnishes, oil varnishes, and lacquers.

2—The difference in the amount of dyestuff required to stain wood a given color with a water or alcohol stain and with an oil stain.

3—The lighter color given to the summerwood of a softwood as compared with the springwood when using an oil stain, despite the apparently deeper penetration into the summerwood.

4—The property of a wood which the finisher calls "suction" and the paint technologist calls "absorption," and which seems to bear no relation to the ease with which the wood can be impregnated with chemicals.

5—The ease with which some oils and resins in woods work their way through paint and varnish coatings, apparently without rupturing them.

6—The development of such exasperating finishing-room troubles as varnish "shrinkage," "pinholing," and "blooming."

7—The apparent development of a third dimension or "depth" in a wood surface when shellacked, varnished, or lacquered.

Spectacular developments such as the widespread adoption of lacquer during the last few years are likely to mislead us into thinking that the important technical advances in wood finishing are to be sought in radically new materials and new methods. Undoubtedly many valuable new inventions will be made as the subject of wood finishing receives more adequate technical study, but it is the author's belief that even more profitable results can be expected from the better utilization of existing methods and materials which will result from a painstaking study of the fundamentals. Already there is a vast accumulation of empirical knowledge, much of it rendered mysterious by an overgrowth of fanciful theory. If the information is subjected to the cold scrutiny of systematic research and every theory examined with a vigorous skepticism, it should be possible to separate facts from fancies and to organize a body of knowledge that will form the real basis of a wood-finishing engineering.

The problem of measuring results

One of the first problems for the future in wood-finishing engineering is the development of tests for measuring results. This is practically a virgin field, because heretofore very little has been accomplished except to finish sample panels and pass judgment upon them by visual inspection. For example, such a property of a varnished surface as "depth" should be susceptible of measurement by a suitable instrument. The trained eye of the experienced finisher seems to be very sensitive to it, but a mechanical "eye" of some kind is essential for a technical study of the property. With proper tools at his command for measuring this and every other significant factor, the engineer would be in a position to determine precisely how much each step and each variation contributes to or detracts from the finishing process as a whole.

The need of adequate tests for evaluating finishes will probably be felt most keenly in its relation to the selection of finishing materials. Every purchaser of such products has realized the difficulty in choosing intelligently among the many brands offered to him. Usually price and the reputation of the manufacturer are taken as the only available index of quality, and the most common method of testing is the hazardous one of using a trial shipment. Attempts to adopt other test methods as the basis of selection have been made often enough but have usually proved abortive.

Trying to borrow the test methods of the chemists of the paint and varnish industries is the most common reason for the failure of the woodworker's efforts to test materials. The varnish chemist, for example, finds a viscosity test very useful as a routine method of control of the uniformity of successive batches of the same varnish; but it does not follow that the viscosity test alone will tell the purchaser which one of several varnishes is most suitable for his use. Again, there is a natural tendency toward the assumption that a chemical analysis of a material gives all necessary information about it. But when the consumer tries to purchase finishing materials on the basis of a chemical analysis he finds himself at once at loggerheads with the makers on the ground that he is attempting an unwarranted intrusion into their trade secrets. Whether the varnish-makers' argument is valid or not, the woodworker will usually find that knowing the formula of a material will not help him much in determining what it will do.

Manufacturers of wood-finishing materials in the past have not found it necessary to devise methods of measuring the service value of their products, and they are not

likely to spend much time in that direction unless the woodworkers themselves lead the way. The author recalls the experience of one large factory which was greatly troubled with varnish printing during shipment of their furniture. The problem was turned over to an engineer who soon devised a test requiring no more elaborate apparatus than some wood panels, some kraft paper, a few weights, and a corner of the factory cellar where temperature and humidity remained constant. When purchases of varnish were made in accordance with the findings of this test the printing troubles were eliminated. It is true that much more time and ingenuity will be required to work out practicable testing systems covering all the requirements of many finishing materials, but where a serious effort is made to do so it is likely to be generously rewarded.

Great Northern carmen's school of instruction at Fridley shops

THE accompanying picture shows a class in the School of Instruction which was organized and established by the carmen of the Great Northern at Fridley shops, Minneapolis, Minn., in October, 1926, under the direction of a committee composed of Earl Davis, Charles Schake and G. G. Woodruff. The students are all members of the Associated Organization of Shop Craft Employees.

From the time of its institution the class held weekly meetings under the instruction of Otto Rasmussen, car

it is believed will be to the advantage of carmen. In the season just ended the class has followed a systematic study of American Railway Association rules and safety appliance laws.

The classes are held in a room provided by the Great Northern in the station building at Minneapolis, from 7:30 until 10 o'clock Thursday evenings. A number of instructive talks were made by railroad officers in the past season.

The value of such internal educational effort has been apparent from the beginning, as demonstrated by increased interest in their work on the part of the men and consequent increased efficiency.

A number of social functions have enlivened the progress of the class, the proceeds going toward the creation of a fund, and the nucleus of a library for the use of class members has already been assembled.

In the picture Otto Rasmussen, car foreman, and instructor of the class, is shown in the lower row, extreme left.

While the instruction school at Fridley shops was the first to be established on the Great Northern system, the importance of the movement was speedily recognized, and similar schools were subsequently instituted and are now functioning at Minot, N. Dak., Havre, Mont., Sioux City, Ia., and another class is now being organized at Superior, Wis.

CLASS I railroads reported to the Interstate Commerce Commission a total of 1,724,243 employees as of the middle of the month of January, a decrease of 49,621, or 2.8 per cent, as



Class of Minneapolis carmen in the school of instruction at Fridley (Minneapolis) shops

foreman at Fridley, with an average attendance of 50 members, until the first of April, when adjournment was made for the summer months. Ambitious plans have been laid for a larger class and an enlarged scope of studies for next season, when it is proposed to take up car building in all its branches as employed at the Fridley shops, and other matters knowledge of which

compared with returns for the preceding month. The total compensation was \$244,565,629, a decrease of \$8,373,862, or 3.3 per cent. Compared with the returns for the corresponding month last year, the number of employees shows an increase of 0.3 per cent, the commission's summary states, but owing principally to an increase of 1 cent in the average straight-time hourly earnings, the total compensation shows an increase of 2 per cent.

Repairing steel cars on the Lehigh Valley

Location of shops on the system facilitates handling repairs to suit traffic requirements

THE principal steel car repair shops of the Lehigh Valley system are located at Packerton, Pa., about 120 miles by rail from Jersey City, N. J., the eastern terminus of the line. This location is especially advantageous in enabling the mechanical department to co-ordinate its steel car repair work with the traffic requirements of the railroad. About 40 per cent of the Lehigh Valley's total revenue tonnage in 1926 was anthracite coal and an additional 6 per cent was bituminous coal. Practically all of this business originates in the Pennsylvania coal fields, and 75 per cent of the anthracite coal is shipped east to tide water, and the remaining 25 per cent to Buffalo, N. Y., and points off the line. The remaining traffic originates at different points on the main line between Buffalo and Jersey City. Seventy-five per cent of the traffic eastbound is loads, while 25 per cent of the westbound traffic is loads.

A general inspection of all westbound freight cars is made in the Packerton classification yards which are located east of the car shops, as shown in the layout drawing of the car repair tracks and buildings. Cars found to be in need of classified repairs are switched over to the car repair yard where a more thorough inspection is made. This inspection determines the class of repairs that the cars scheduled to go through the Packerton car shops are to receive.

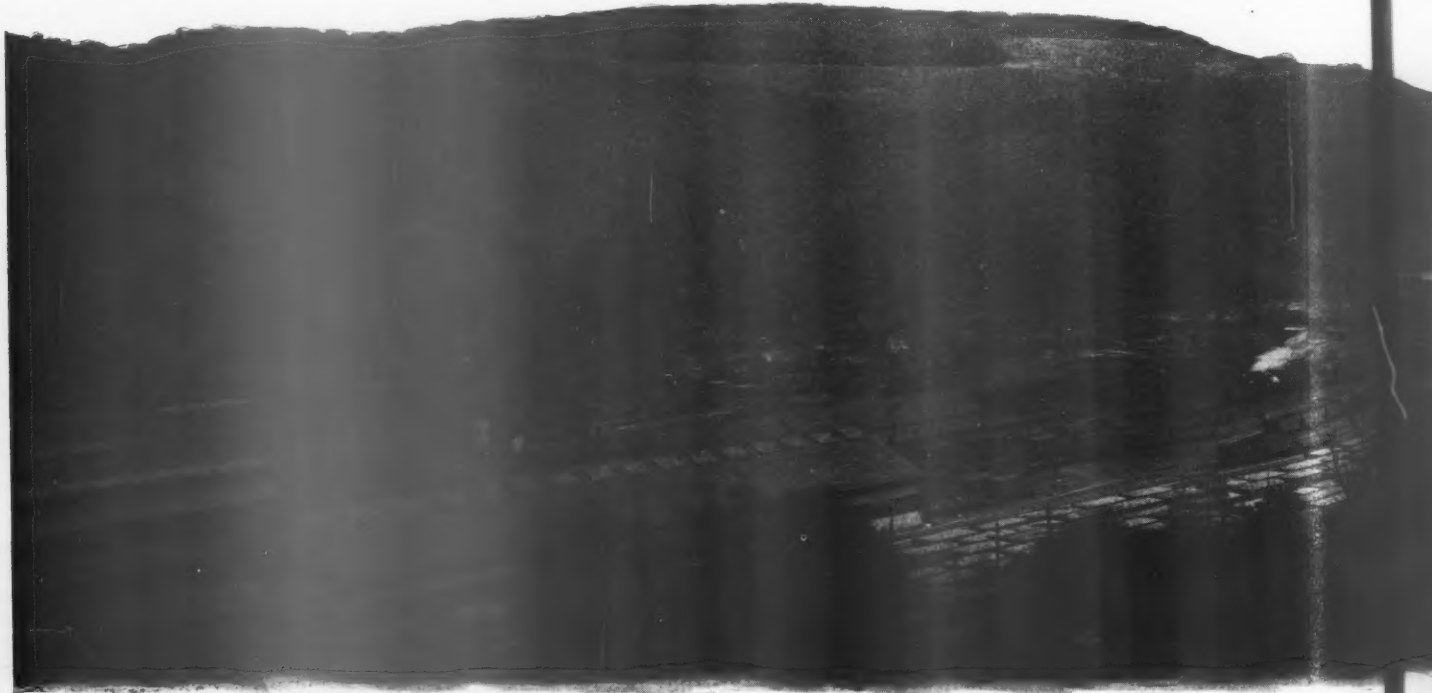
Cars of any series requiring light repairs are spotted on repair tracks outside the gantry crane area and the repairs to each car are handled separately. Cars requir-

ing class repairs are placed on tracks leading under the gantry crane.

Program of repairs is planned in advance

The heavy repair work done at Packerton shops is handled according to a definite program which was planned and adopted during 1923. This program or schedule of repairs is based on records and inspection reports for each series of cars on hand requiring heavy repairs, it being the policy of the mechanical department to send one series of cars through the Packerton shops at a time.

Cars to go through the shop for repairs are switched in at the west end of the yard and a tin tag showing the car number is placed on each car. Cars due for Class 1, 2, 3 or 4 repairs are taken to tracks 1 and 2 of the westbound yard. Here the cars are given a thorough inspection, the inspector marking the various parts and body sheets to show whether they are to be renewed or scrapped. The first operation, after the inspection, is to burn the heads off all the rivets. This work is performed by one man who can burn the heads off 230 rivets per hour under favorable working conditions. All the sheets, appliances, etc., are removed from all cars scheduled for heavy class repairs as they go through the shop. Old sheets, car parts, appliances, etc., are reclaimed wherever possible and sorted according to probable wear. Reclaimed material is only placed on cars on which all parts are estimated to give about the same wear, so that when a car returns to the shop, all parts



View of the steel car shops at Packerton, Pa.

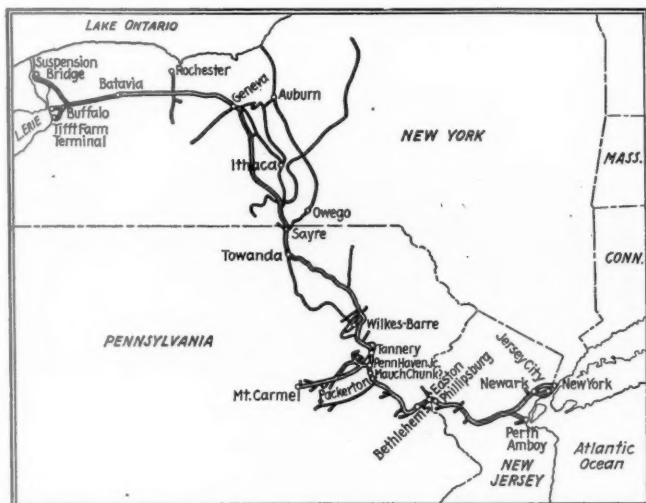
have reached approximately an equivalent condition with respect to renewal. Good parts of old sheets are used for patches on cars receiving Class 5 repairs.

An average of 12 cars is placed on the burning-off tracks, the burner only leaving sufficient rivets to hold

The third operation is performed further along the repair tracks running under the gantry crane, and consists essentially of such work as splicing the center sills and repairing the underframe and hopper sheets of the cars.

In the fourth operation the floor sheets are applied and the car is made ready to receive the side sheets. As shown in one of the illustrations, the floor sheets are piled on a platform resting on trestles, the top of the platform being at the same level as the floor of the car. Each sheet is removed from the pile on the platform as needed by the gang working at this station.

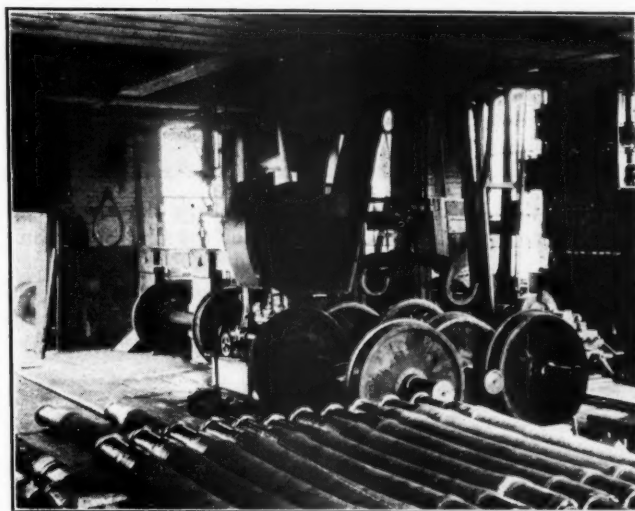
The side sheets are handled the same way in the fifth



The Lehigh Valley system

the cars together while they are being switched to the second station, which is located on the tracks at the west end of the gantry crane area, where they are dismantled.

The second operation is performed at this station which consists of backing out the rivets. This work is done by two men who drop the couplers and draft gears and remove all parts marked defective. All defective parts and all other material are handled by the 10-ton gantry crane. Defective parts are routed to the repair shop concerned and good material after inspection at the repair shop, is set to one side to be returned to the car. Air brake equipment and safety appliances are routed to the air brake and blacksmith shops, respectively.



Interior view of the wheel shop

operation, from platforms of similar construction. In this operation the side angles and ends are also applied. The floor and side sheets are fitted and held in place by bolts. Rivet holes that do not match are reamed out by one man with an air reamer. A "miscellaneous gang" drives all rivets that cannot be placed after the



shops of Lehigh Valley, Packerton, Pa.

side and floor sheets have been put on the car, such as hopper sheet rivets, etc.

Upon completion of the fifth operation, the car is

being attached to a carrier consisting of a short piece of rail on which the shank of the coupler rests and two supports at each end of the rail which are



Cars are spotted on tracks 1 and 2 where the rivet heads are burned off—This work is part of the first operation



Floor sheets are applied at the fourth station and side sheets at the fifth station

moved to the sixth station where it is set on trestles, the trucks moved out from under the car and taken by crane to the truck repair track. This operation also

held apart at the top of the supports by a spreader.

Hopper doors are fitted and riveted on a special rack which is shown in one of the drawings and also an illus-



The rivets are backed out in the second operation



Body sheets bolted in place awaiting final riveting

includes applying the couplers, draft gears, safety appliances and brake equipment, and riveting. The crane is used to raise the couplers to position, the crane hook

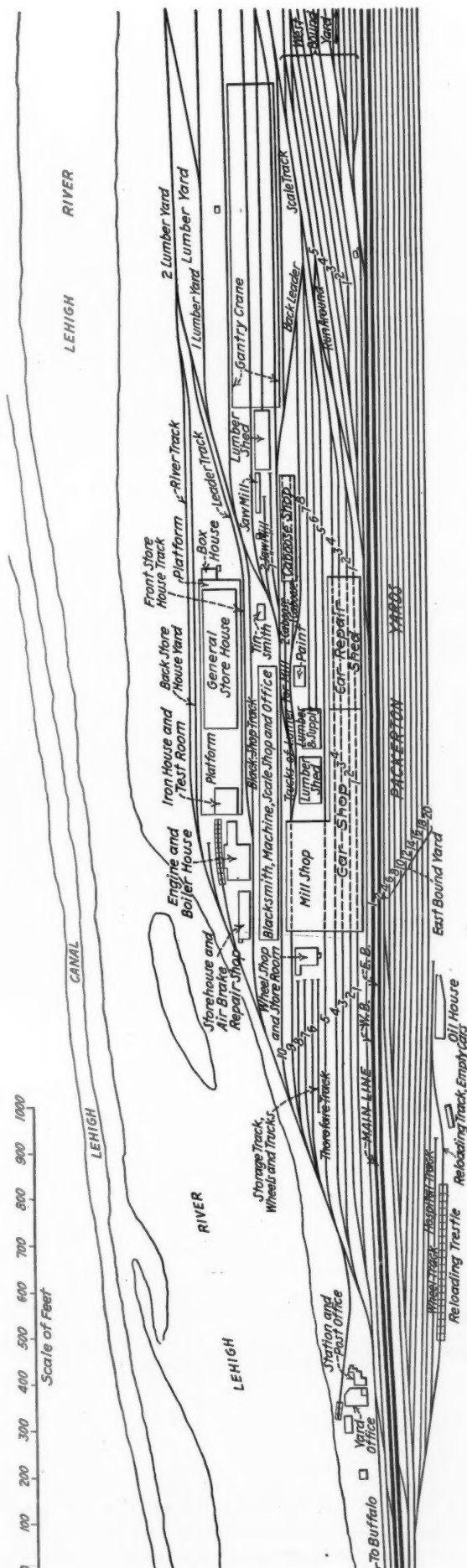
tration. These doors are applied to the car in the sixth operation. This rack is fitted with body hinges to which the car repairman fits the door hinges before reaming



The third operation is performed at this station, which includes repairing the center sills and underframe



The cars are set on trestles at the sixth station while the trucks are being repaired



Layout of the shop buildings, repair tracks and classification yard of the Lehigh Valley, Packerton, Pa.

the holes and riveting the hinges to the door. All the work of reaming and riveting on these doors is performed on this rack.



Trucks are carried by the gantry crane from the sixth station to a separate track where they are repaired

The foreman in charge of the truck gang inspects each truck as it arrives at the truck repair track and supervises the repairs. The trucks and air brake appli-



Rack for fitting and applying hinges to hopper doors

ances are placed under the car before it is moved to the seventh station.

An air-operated winch is used to move the cars to



Rivet bins are located at points convenient to those stations where most of the riveting is done

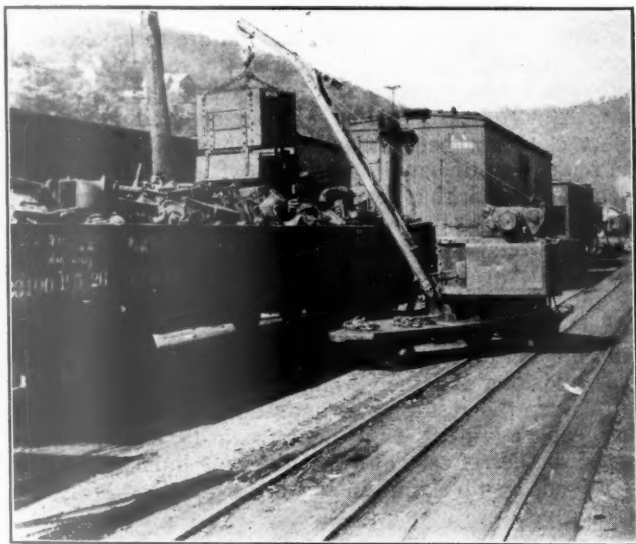
mill for bolts, cotters, pins, etc. One man is assigned the job of keeping these bins replenished, who also picks up all good material and sorts it. The woodworking machines in the mill adjoining are located north of track 5.

All material delivered to the repair yard and shops is handled by the stores department. Each kind of material is delivered to a designated station from which the car repairmen get the material they need. Two men handle all small material, partly over narrow gage tracks running to various parts of the plant, and partly with electric and hand trucks. Heavy material is placed on cars which are switched by the yard engine crew. This material is handled by laborers from the storeroom.

Practically all the work performed at Packerton is done on a piecework basis. The cost system used is the same as that described in the December, 1926, *Railway Mechanical Engineer*, page 759.

An average of 510 men are employed at Packerton shops and the various inspection points under the jurisdiction of the shop superintendent. About 400 men are employed in the shops proper.

Each Saturday a meeting of the supervisory staff is held in the office of the shop superintendent. Various subjects concerning the car repair situation on the system are discussed, the program for each meeting being planned in advance by the shop superintendent. A weekly memorandum from the superintendent of motive power pertaining to car department matters is also discussed. A record of each meeting is kept, somewhat in the form of minutes and copies are mailed to all shop



Handling small scrap with an electric crane truck—The box is fitted with drop bottom doors controlled by the truck operator

superintendents and master mechanics on the system under the head, "Weekly Letter of Economies." This letter is of considerable assistance in obtaining co-ordination between all repair points, especially in informing all those concerned as to the problems being worked on at other car and locomotive repair points on the system.

"MODERN CARS AND LOCOMOTIVES" is the title of a pamphlet which has been issued by the Pennsylvania Railroad, giving illustrated descriptions of 14 of its principal types of locomotives, eight types of passenger-train cars and eight of freight service cars, together with some brief notes on the history of this branch of railroading. The circular has been prepared as the best means of responding to numerous requests from educational institutions and elsewhere for information of the kind shown.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Receiving line should have secured protection

On July 31, 1924, the Gulf, Colorado & Santa Fe delivered to the Gulf Coast Lines at Algoa, Texas, St. L. B. & M. box car No. 1245 empty, in interchange. Exceptions were taken to certain defects by the G. C. L. inspector and requests made on the G. C. & S. F. inspector for protection covering the defects. The car was later inspected and moved to the shop. The G. C. L. requested the G. C. & S. F. to furnish a statement in accordance with Rule 43, with which request the latter road declined to comply. The subsequent inspection, made on August 8, 1924, is alleged to have revealed certain defects which the delivering lines contends could easily have developed during handling by the receiving line. The G. C. & S. F. made an exhaustive investigation to determine the defects existing at the time the car was delivered to the Gulf Coast Lines and was able to state positively that only a certain portion of the defects noted on the subsequent inspection report existed at the time of interchange. The contention of the G. C. & S. F. was that the G. C. L. failed to comply with the rules or with the precedents established by the decisions in Cases 1291 and 1350.

The Arbitration Committee sustained the contention of the G. C. & S. F. in view of the fact that the G. C. L. failed to procure protection.—Case No. 1447—*Gulf Coast Lines vs. Gulf, Colorado & Santa Fe*.

Responsibility for car damaged in switching

Central Vermont box car No. 83210 having a metal underframe and of 60,000-lb. capacity, was damaged when two other cars switched over a hump in charge of a car rider on the Pennsylvania at Wilmington, Del., coupled onto the standing cars. Certain defects developed which made it necessary to jack up the entire car superstructure to make repairs, the total cost of which amounted to \$375.17. The Central Vermont claimed that the car was not in good condition when accepted by the Pennsylvania and that the defects are handling line's responsibility because the brakeman failed to control the car properly while being switched. The Pennsylvania contended that the cars being switched were given the necessary rider protection, the brakes having been tested and pronounced o.k. before leaving the hump, but that the defects developed in spite of these efforts. No cars were derailed nor subjected to any other conditions coming under the provisions of Rule 32, nor was any buckled outward. The car failed in spite of the rider's in the line of standing cars and was loaded with cement. The Pennsylvania contended that to damage the second standing car only without having damaged the first car in the line of standing cars, might indicate an inherent structural weakness. In this case the metal center sills did not have a cover plate and the center of the car buckled outward. The car failed in spite the rider's

efforts when the coupling was made at a speed estimated at four miles per hour without any negligence being involved.

The Arbitration Committee rendered its decision to the effect that the car was not damaged under any of the provisions of Rule 32 and that the car owner is responsible. The Committee cited decisions 1307, 1312 and 1321 as parallel.—*Case 1448—Central Vermont Railway vs. Pennsylvania.*

Defect card void in accordance with Rules 5 and 94

Houston & Texas Central car No. 11736 arrived on its home road July 1, 1921, carrying a defect card dated May 11, 1921, issued against the Chicago & North Western. On November 24, 1923, almost two years and five months after the first receipt of this car on its home line, the Southern Pacific made repairs to items covered by the defect card and rendered a bill against the Chicago & North Western, using the defect card as authority for the bill. The Chicago & North Western took exceptions to the charge, contending that the defect card was void in accordance with A.R.A. Rules 5 and 94. The Southern Pacific maintained that the time limit mentioned in these rules does not apply for the reason that in this case the repairing line is not the car owner. In its statement of facts the C. & N. W. maintained that the failure on the part of the H. & T. C. to make repairs while the car was on the home line and avail itself of the protection afforded by the defect card should make the car owner and not the carding company responsible to the repairing line, in view of the fact that the repairs were not made within the two-year time limit specified in Rules 5 and 94.

The Arbitration Committee rendered a decision sustaining the contention of the Chicago & North Western and added "In any case of repairs made by other than car owner, where time limit on the defect card has possibly expired under Rules 5 and 94, bill, accompanied by defect card may be rendered against car owner subject to the time limit of Rule 91. If investigation by owner develops that time limit has not expired counter bill may be rendered against company issuing the defect card."—*Case 1449—Chicago & North Western vs. Southern Pacific.*

Charges for replacing broken inside door protection boards

Before moving Denver & Rio Grande Western car No. 62987 over the Northwestern Pacific lines, a car inspector found the door protecting boards broken and the side door bulged out on the right side of the car. Eight pieces of 1-in. by 6-in. by 8 ft. pine were applied to the inside of the door opening and the load adjusted. Authority for transfer or adjustment of the lading was issued and used as a basis for the bill rendered by the N. W. P. to the D. & R. G. W. The owner stated that the adjustment authority furnished by the N. W. P. did not show that the door protection removed was improper nor did the delivering line furnish any information to show that the door protection boards were improper as defined by the loading rules, except to say that the boards must have been improper as to size, else they would not have broken in transit. The owner contended further, that paragraph (h), A.R.A. Rule 2, and paragraph (e), car service Rule 14, did not cover cases of door protection failing when such protection meets the requirements of the loading rules. The N. W. P. stated that it could not

be held responsible for the damage under any provision of the A.R.A. rules and that the delivering line is also relieved, for reference to Rule 2, paragraphs (g) and (h), which in turn refer to Car Service Rule 14, second section, paragraph (e), places the responsibility with the originating road for improper door protection.

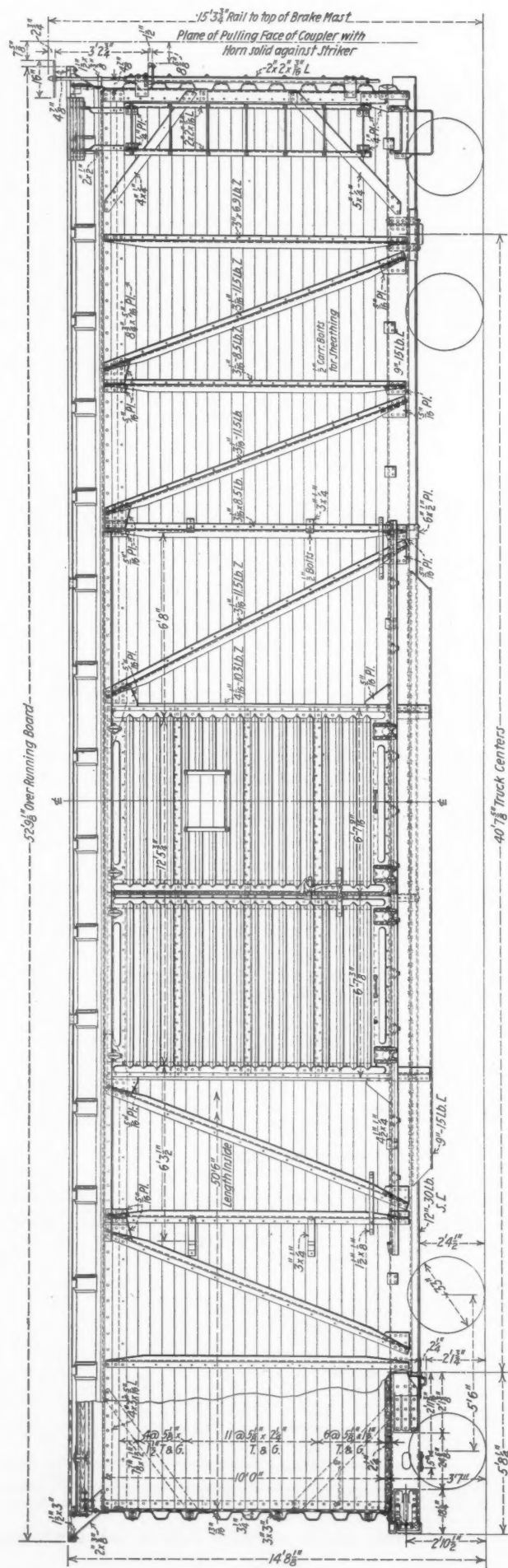
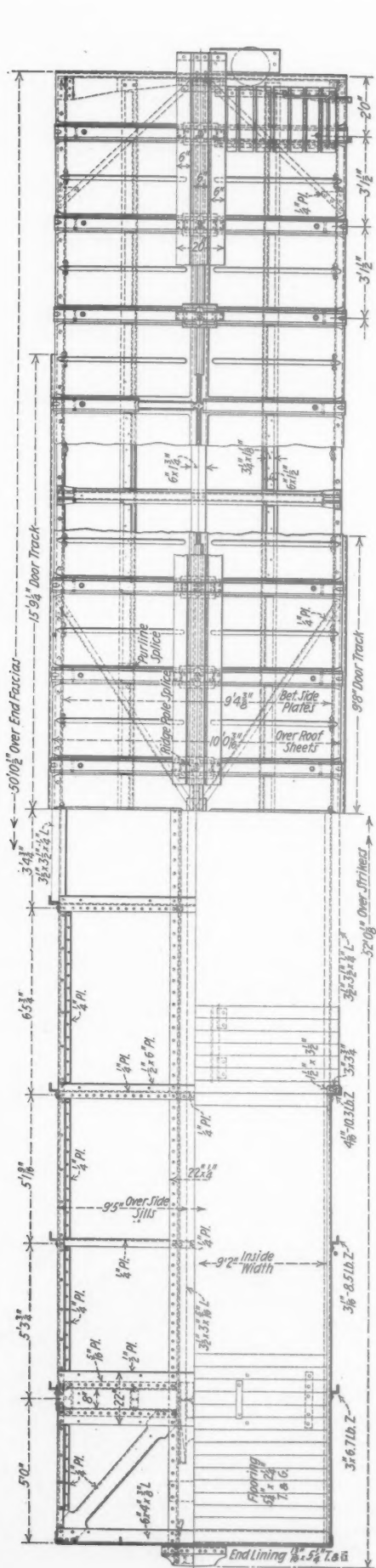
The Arbitration Committee in rendering its decision stated that the second paragraph of section (h), Rule 2, in connection with section (e) of Car Service Rule 14, does not apply in this case. The case is subject to Rule 2, section (c) and (g) and the first paragraph of section (h), the delivering line being responsible.—*Case No. 1450, Denver & Rio Grande Western vs. Northwestern Pacific.*

Defect card should cover both labor and material

On January 1, 1925, HBX car No. 100 developed, under ordinary circumstances, a broken Cardwell draft yoke and casting while on the Illinois Central. The handling line applied draft springs and pullover plates, having no material in stock to replace the car owner's standard, and applied a defect card to cover the wrong repairs which was not marked "Labor only" as per A.R.A. Rule 88. The Chicago Great Western corrected the wrong repairs, at which time repairs were made to the brake rigging at the A-end of the car. The C.G.W. made a charge against the I.C. for both labor and material for correcting the wrong repairs on authority of the defect card which was found on the car and against the car owner for repairs to the brake rigging. It was the contention of the C.G.W. that failure to have the defect card read "Labor only" placed the responsibility for both labor and material for correcting the wrong repairs with the carding line, further contending that the defect card not being marked "Labor only" precluded the possibility of handling as per A.R.A. Rule 88, interpretation No. 3, thus leaving the C.G.W. to assume that the case was properly handled under A.R.A. Rule No. 38, interpretation No. 4. The C.G.W. stated that to cancel its charge against the I.C. at this time would not permit them to bill the car owner according to Arbitration Decisions Nos. 1061 and 1097. The Illinois Central objected to the material charge of the C.G.W. under the provisions of Rule 88 and contended that as the repairs were the result of owner's defects, the material is chargeable against the car owner regardless of the wording of the defect card and that the time limit under Rule 91 afforded ample time in which to handle the case accordingly.

The Arbitration Committee in rendering its decision ruled that the defect card in question is full authority for the bill for the material as well as labor. The principle of Decision No. 1398 applies. The bill of the Chicago Great Western is sustained.—*Case No. 1451, Illinois Central vs. Chicago Great Western.*

THE UNITED STATES MASTER SPECIFICATION for tender hose, which was officially revised by the Federal Specifications Board on October 28, 1926, for the use of the Departments and Independent Establishments of the Government in the purchase of tender hose, is contained in the second edition of Circular 288 of the Bureau of Standards, Department of Commerce. The hose, used to connect the water tank on the tender with the injectors on the locomotive, consists of (1) an inner rubber tube, (2) two plies of cotton duck, (3) a helix of wire, (4) a layer of rubber, (5) two plies of cotton, and (6) an outer cover of rubber. The specification, prepared in co-operation with the Rubber Association of America, provides detail requirements regarding sizes, construction, properties of materials used, method of inspection, and tests.



General arrangement drawing of the new automobile cars for the Chicago, Milwaukee & St. Paul

per. Interlocking weatherproof seals are furnished at the rear of each door and are also provided at the center where the doors come together.

The steel center posts are fitted with wood fillers and have an automatic locking attachment. The grain door nailing strips at the door post fillers have been especially designed to fit flush with the lining and thus avoid damage to the lading or annoyance to shippers when unloading automobiles. Difficulty is also avoided when these cars are loaded with grain or a similar commodity and scrapers are used for unloading purposes.

The Dreadnaught steel ends, consisting of three pressed steel sections, are completely weatherproof and lined with 13/16-in. vertical sheathing resting against 3-in. by 3-in. furrings. The sides of the car are lined, starting with the floor, with six rows of 5 1/8-in. face by 1 1/2-in. tongued and grooved fir. This is followed by 11 rows of 5 1/8 in. face by 2 1/2 in. tongued and grooved fir. Above this, four rows of 5 1/8-in. face by 1 1/2-in. tongued and grooved fir lining, and superimposed above this is a strip 7 7/8-in. face by 1 1/2-in., grooved only, this latter member being secured to the side plate. The flooring is 2 1/4-in. thick, tongued and grooved fir securely fastened at the ends and fitted with positive grain seals.

The end sill is secured to the side sill with underframe diagonal braces shown on the general drawing, in conjunction with malleable push pole pockets. The side sills are also arranged with a combination roping staple and jacking casting at each bolster. The cars have an over-all maximum height from the rail to the top of the brake mast of 15 ft. 3 3/4 in. The extreme width of the car over the roof sheets is 10 ft. 3/16 in.; the height from the top of the rail to the eaves is 13 ft. 9 in.

The underframe construction consists of center sills in one piece from striking casting to striking casting made from two 12-in. 30-lb. channels, one 22-in. by 1/4-in. top cover plate and two 3 1/2-in. by 3-in. by 5/16-in. rolled steel bottom chord angles.

The bolster center filler and draft gear stop member is an integral steel casting. Body bolsters are formed from 5/16-in. pressed steel flanged diaphragms, spaced 8 in. apart with a reinforcing casting over the body side bearing. Cover plates 2 in. by 1/2 in. extend from side sill to side sill.

The floor supports are of 1/4-in. pressed steel flanged plate. Cross bearers, four in number, are formed from 1/4-in. pressed steel flanged diaphragms with 1/2-in. by 6-in. cover plates running from side sill to side sill. Diagonal bracing is provided between the side sill reinforcing channels at the door opening.

The Hutchins all-steel galvanized flexible iron roof is fitted with diagonal roof braces at each end and at the center of the car. Running boards are spliced in two places and fitted with a special wide saddle having 4-in. by 3/16-in. steel plate fitted flush into the boards and held in place with bolts.

An interesting feature of the work on this car was the calculation of stresses and deflections due to various loads applied to the permanent loading rail and then seeing how these figures checked with actual measured deflections under test loads. The table shows the results of these tests with a concentrated load applied midway between two carlines (the most severe condition). While weights up to four tons were handled, this caused an actual deflection of 1.69 in. and a permanent set of 1/4 in., whereas the stress and deflection figures indicate that loads up to two tons can be readily handled with a reasonable factor of safety and no permanent effect on the car superstructure.

Referring to Fig. 1, it is evident that the concentrated

load P applied to the loading rail at the center of the car will cause a deflection in the loading or lifting rail directly under load, but also at its connections to roof carlines $8a$ and $8b$, and probably also at $7a$ and $7b$. However, the deflection at the latter points would be very

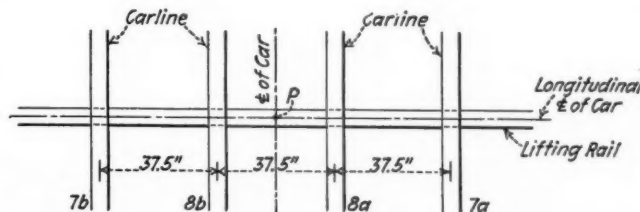


Fig. 1

small, and for all practical purposes negligible. Hence, it is fair to assume that the deflection in the rail under load may be calculated by the formula—

$$\text{Deflection} = \frac{1}{192} \times \frac{P l^3}{EI} \text{ for fixed end beam.}$$

$$l = 112.5 \text{ in. } E = 30,000,000 \quad I = 1.23$$

The results thus obtained would probably be higher than that found in actual measurement, as evidenced by the fact that the calculated deflection follows curve A , Fig. 2, while in reality it probably follows curve B .

Deflection in the loading rail at $8a$ and $8b$ must be equal, since the load is centrally located, and the amount



Fig. 2

of deflection is small (the loading rail being supported by carlines $8a$ and $8b$.) Therefore, it may be assumed that in computing the bending moment in the loading rail, it shall be considered as a simple beam having supports at $8a$ and $8b$.

$$\text{Bending moment} = \frac{1}{4} Pl, \text{ where } l = 37.5 \text{ in.}$$

Stress and deflection in loading rail with various concentrated loads applied midway between two carlines

Load	Calculated results			Observed results	
	Bending moment, in.-lb.	Stresses, lb. per sq. in.	Deflection, in.	Deflection, in.	Spread at side plate and sag in side plate
4000 ...	37,500	33,500	.81	.81	1/4 in.
5000 ...	46,800	41,800	.999	.94	1/8 in.
6000 ...	56,200	50,200	1.215	1.06	3/8 in.
7000 ...	65,600	58,600	1.404	1.31	1/2 in.
8000 ...	75,000	67,000	1.593	1.69	3/4 in.
Permanent set in loading rail, 1/4 in.					

Hillyard car shop kinks

AT the Great Northern car shops at Hillyard, Wash., extensive rebuilding and construction programs are carried out involving the use of large quantities of lumber, and the Hillyard mill room is equipped for roughing out and finishing this material. Three of the illustrations show devices employed in the mill room to expedite this work, and the other two show the type of three-wheel trailer and tractor system largely used in transporting lumber from the lumber storage yard to the mill room and from there to the various points in car shops and yard where it is applied to cars.

Referring to the first two illustrations, an attachment is shown applied to a four-side planer and used for grooving, beading, or cutting any other special shapes just before the lumber leaves the four-side planer. By

this method, one handling of the lumber and one pass through the separate machine generally used for this purpose, are saved.

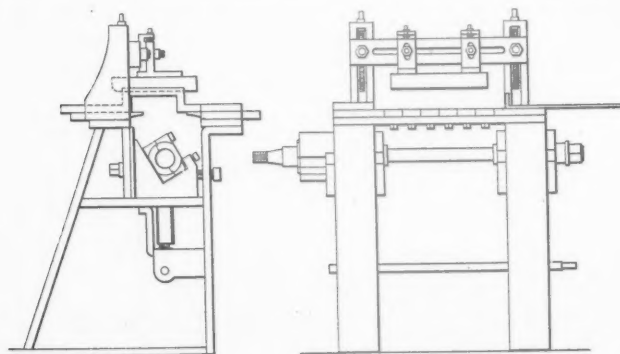
The attachment with rotating knives is rigidly secured at the rear of the planer bed and driven directly from the planer itself. Adjustable guides are provided to accommodate different widths of stock and full adjustment of the pressure bar is also afforded by means of slots in the knee brackets and the two square thread screws and operating handles shown.

The pneumatic clamp is shown applied to a mortising



Four-side planer attachment which saves one handling of the lumber

machine, but can as readily be applied to a number of other mill room machines. It is a simple device and a great time saver, consisting simply of a knee bracket adjustable on the machine table and carrying a $6\frac{1}{2}$ -in. pneumatic cylinder inclined at an angle of about 30 deg., with the table. On the end of the piston rod is a jaw having teeth which grip the timber. It is evident from the illustration that air pressure exerted in the cylinder will move the piston rod and jaw, not only holding the



Details of planer attachment used at the Hillyard shops

timber against the vertical column of the machine, but securely clamping it to the table while being machined. A small three-way valve controls the supply and exhaust of air from the cylinder, a suitable spring returning the piston to the upper part of its stroke after each application.

A great deal of labor is saved in handling lumber at the Hillyard car shops by the use of the three-wheel trailer shown in one of the illustrations. Trailers of this type are all substantial in construction with large diameter wheels, promoting easier hauling about the shop grounds. By having an adequate number of these trailers in reserve, lumber can be handled from the storage

to the cars, often without touching the ground or shop floor.

The method of coupling the tractor to the three-wheel



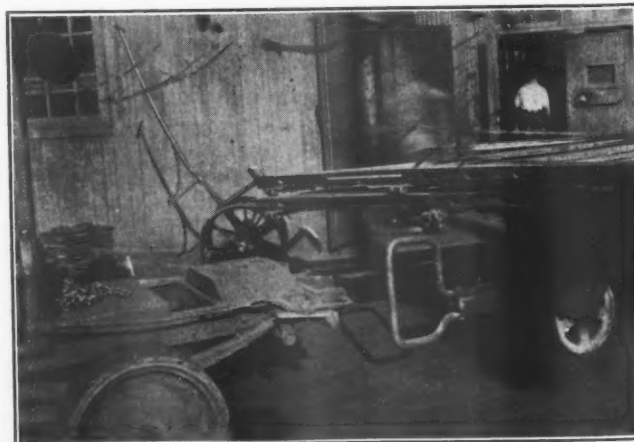
Pneumatic clamp applied to a mortising machine

trailer is shown in another of the illustrations, the operation being performed entirely from the driver's seat. Formerly, a chain was used for this coupling, making it



Three-wheel trailer which saves labor in handling lumber

necessary for the tractor operator or one of the carmen to be constantly on the job chaining and unchaining trailers. The present arrangement consists of a spring-sup-

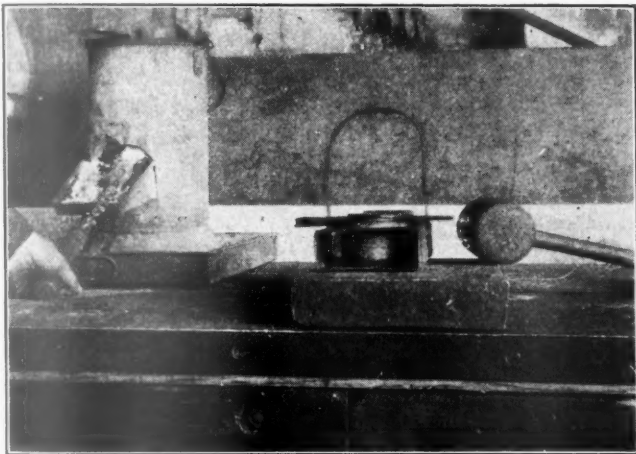


Tractor and trailer coupler arrangement—The tractor can be uncoupled by the operator without leaving his seat

ported gathering device, which enables the tractor to be backed approximately to the correct position, when the trailer drawbar will immediately swing to the proper alignment and be held by the tractor coupler. When necessary to disconnect the trailer it can be uncoupled by the tractor operator without leaving his seat, by means of the bell crank and lever arrangement with operating handle conveniently located with respect to the driver's seat.

Convenient tray for carrying acids

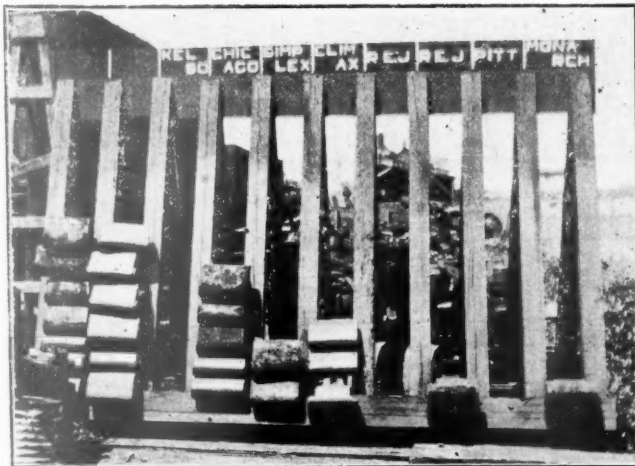
ACIDS used by the tinsmiths are dangerous fluids to carry about. To prevent them from spilling readily a simple tray has been devised which is handy and comparatively safe. It is made of light



A tray designed to prevent acids from spilling easily

sheet metal formed in a rectangular box 6 in. wide by 12 in. long, with an arched handle of somewhat heavier material soldered on. In the top of the tray, two holes are cut of the correct size to fit the glass or jar in which the acids are carried. The brushes may be carried within the tray beside the jars.

•• •• •• ••



Rack for storing coupler knuckles—The type and style of each knuckle is printed on a board secured to the top of the rack

Rig for handling large cover plate sheets

IN punching rivet holes in long sill cover plates 2 ft. wide and 30 ft. long and only $\frac{1}{2}$ in. thick, it was necessary in the steel car shop of the D. & R. G. at Denver, Col., to transport the sheets with an overhead crane from one end of the shop to the other, hold them while punching and then bring them back to the starting point. This proved to be a slow and troublesome task until a triple sling was devised. A strong forked chain, 6 ft. long



A chain rigging for handling long narrow sheets in a steel car shop

with a flat stirrup-shaped hook at the end of each fork, was secured by a large clevis to each end of a 1-in. by 4-in. steel bar, 20 ft. in length. Another pair of chains were swung from a pulley which could be moved back and forth on top of the bar at any point between the other two sets of chains. The rigging was suspended from an overhead crane with the usual heavy chains which hooked into a pair of large clevises near the ends of the bar. By this means the sheets were held almost level while being moved to the machine, punched and returned to the car.

FLEXIBLE METALLIC CONNECTIONS.—The Vapor Car Heating Company, Inc., Chicago, has just issued Booklet No. 42, describing Vapor flexible metallic connections for use in train service and at terminals. The importance of providing for safe, satisfactory and economical metallic steam connections on locomotive and passenger cars, and in passenger yards, is emphasized in the booklet, which also strongly recommends the use of two-inch steam heat connections on both locomotives and cars. This larger area through the steam connections practically doubles their capacity and, when changing engines at terminals, enables steam to be gotten through to the rear of long trains in about one-half the time required where the usual restricted couplings are used, thus assuring sufficient steam at the rear for heating the last cars in long trains. This new booklet also gives the various sizes of Vapor flexible joints for use in passenger yards, enginehouses, stations, etc.

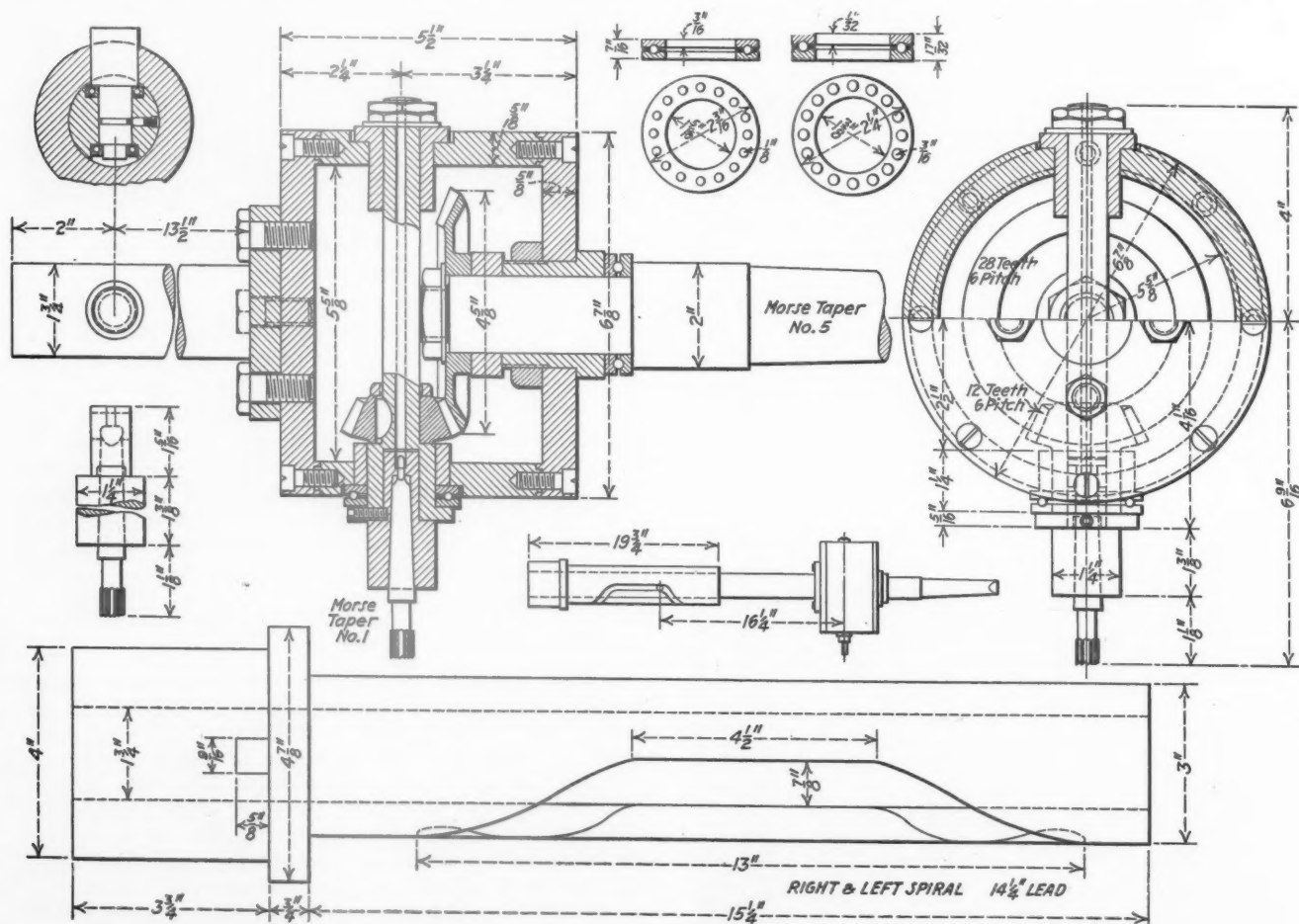


Tool for milling grease grooves in driving box crown brasses

THE tool shown in the illustrations was designed for milling the grease grooves in driving box crown brasses and can be used either on a drill press or a horizontal boring mill. Two grease grooves

connect with the large grease cavities. The grease grooves were formerly cast in the brasses which did not prove satisfactory, because the core sand remaining in the grooves caused hot bearings.

The tool used for milling the grease grooves is an ordinary $\frac{3}{8}$ in. end mill which is driven by a set of bevel gears enclosed within a housing made of a piece of steel tubing on which end bearings are bolted. The spindle is equipped with thrust bearings and bronze bushings.



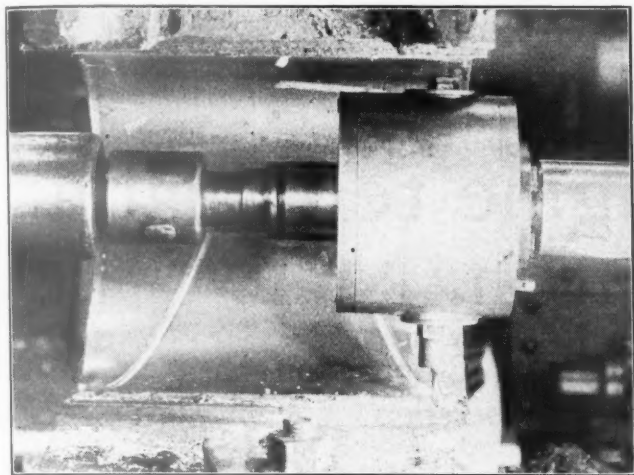
Construction of a special tool for milling the grease grooves in crown brasses

are milled in the crown brasses as shown; these grooves are $\frac{1}{4}$ in. deep on the outer edge of the crown brass and $\frac{3}{4}$ in. deep in the top of the crown brass where they con-

nect with the large grease cavities. One end of the housing is equipped with a standard Morse No. 5 taper shank to fit the spindle of the machine. To the opposite end of the housing a shaft is

attached, which carries a hardened steel pin. This pin is free to slide in the hardened sleeve, which is attached to the opposite end of the machine in a stationary position. This sleeve is a guide and in it is milled a right and left hand spiral groove, with $14\frac{1}{4}$ in. lead. This arrangement makes it possible to set up the box and mill the groove nearest the operator, then unlock the spindle feed, advance the end mill through the straight slot and start the opposite groove from the top of the crown brass. This simplifies the different operations of milling the two grooves.

The depth of cut is controlled by feeding the work to the tool instead of feeding the tool. This also simplifies



The crown brass grease groove milling tool in use on a horizontal boring mill

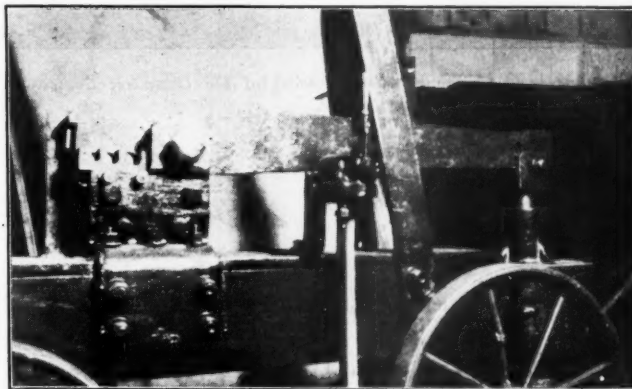
the operations. This tool will be found very useful in milling the grease cavities in crown brasses, trailer truck bearings, back end main rod brasses and other bearings. The actual time per groove for milling the grease grooves in the driving boxes such as the one shown in

Portable pneumatic bolt and scrap cutter

By H. H. Henson

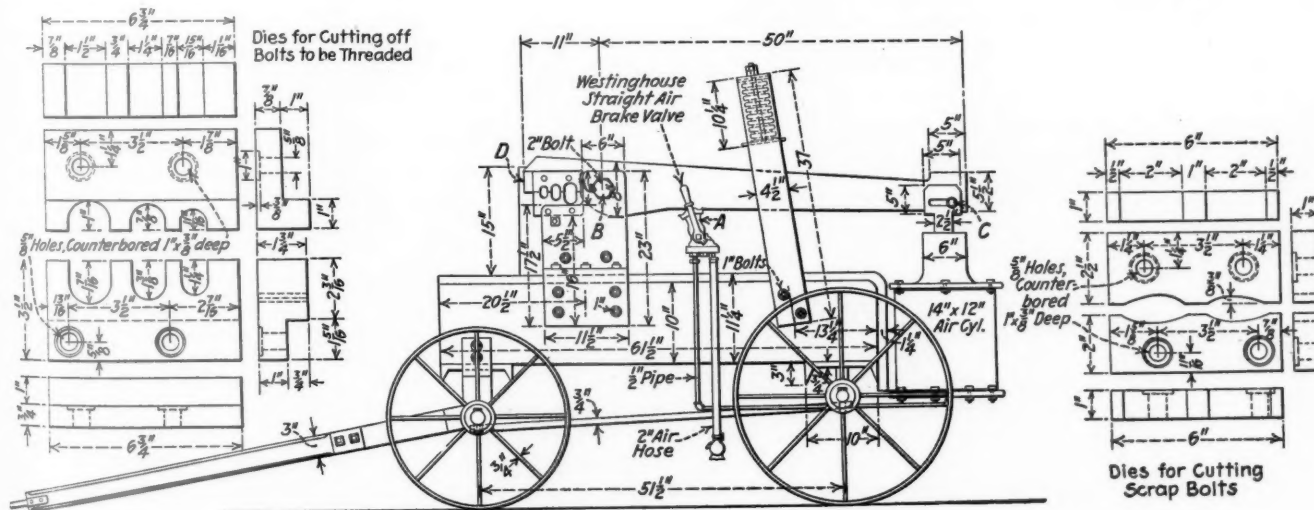
Machine shop foreman, Southern, Chattanooga, Tenn.

THE frame of the portable pneumatic bolt cutter shown in the illustrations is constructed of 1-in. by 10-in. channel iron and iron plates 1 in. thick by 12 in. wide by $61\frac{1}{2}$ in. long. The cutting lever is actuated by a 14-in. by 12-in. air brake cylinder. The distance



A portable pneumatic bolt and scrap cutter

from the fulcrum pin *B* to the pin *C* is about 50 in. and the distance from pin *B* to the outer end of cutter *D* is about 11 in. The air supply to the cylinder is controlled by a Westinghouse straight air brake valve. Either of the two sets of cutters illustrated can be used on the bolt cutter. The cutters shown at the left are used for cutting off bolt stock that is to be threaded. The cutters at the right are intended for use in cutting scrap bolts of any size from $\frac{3}{8}$ in. to $1\frac{1}{8}$ in. in diameter. These cutters

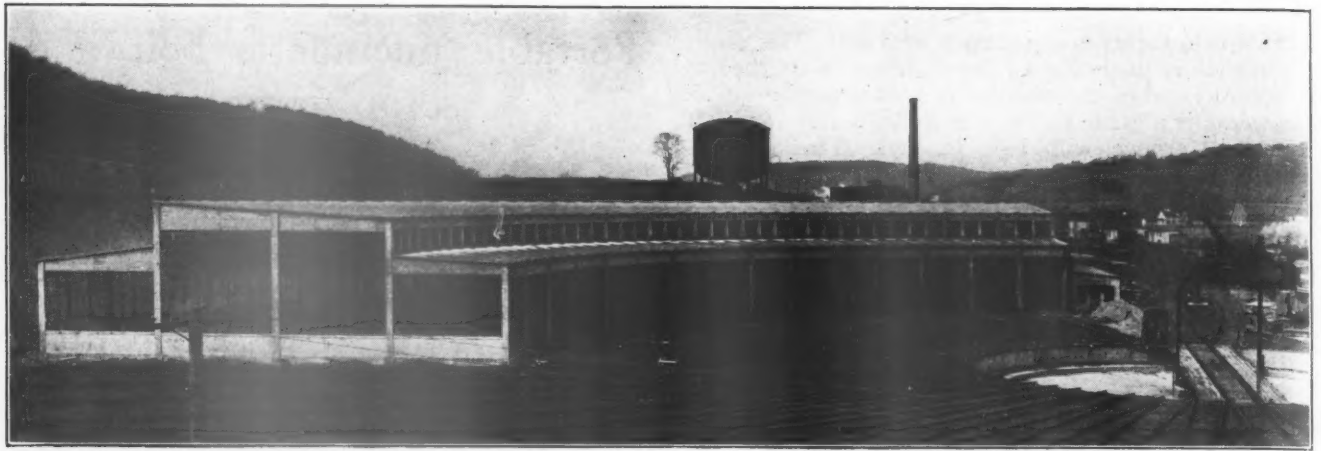


General dimensions of the portable pneumatic bolt cutter and the cutting dies

the illustration is $1\frac{1}{2}$ min. per groove, not including the set-up time, which should not run over five to ten minutes per box. Only one set-up is necessary to mill the two grooves. The time for the set-up will vary according to the facilities available for handling the driving boxes.

are so designed that the stock can be readily cut off without taking any particular care in locating it between the cutting edges.

As the bolt cutter is mounted on wheels it can be moved around the shop and put in operation wherever connections can be made with the shop air line.



Enginehouse and locomotive storage tracks of the Delaware, Lackawanna & Western at East Binghamton, N. Y.

The D. L. & W. engine terminal at East Binghamton, N. Y.

Removal to outside the city limits of Binghamton has resulted in more efficient operation

By M. A. Quinn

Master mechanic, Delaware, Lackawanna & Western, Binghamton, N. Y.

THE placing in operation of the new yard and engine terminal by the Delaware, Lackawanna & Western at East Binghamton, N. Y., in December, 1925, has not only effected economies in operation by providing modern facilities, but has also relieved considerable congestion by removing the yard and terminal facilities from the city of Binghamton to a point where it is unhampered by urban conditions or the proximity of other railroads.

Binghamton is a city of approximately 75,000 inhabitants on the main line of the Lackawanna about midway between New York and Buffalo and is the northern terminus of the triangular shaped Syracuse and Utica division. In the city, two other railroads lie north and nearly parallel to the Lackawanna and it was necessary, in the old location for all Syracuse and Utica division locomotives to cross the tracks of these railroads on their way to and from the engine terminal. The crossings were protected by three interlocking plants and these as well as the inadequate length of the train sidings, sometimes caused serious delays in train and light engine movements. After a study of the situation it was decided to construct a new classification yard and engine terminal east of the Susquehanna river, located to the south of the main line where the railroad company some time previously had acquired a large tract of land and erected a modern coaling station, water ash pit and pumping plant.

The new classification yard and engine terminal

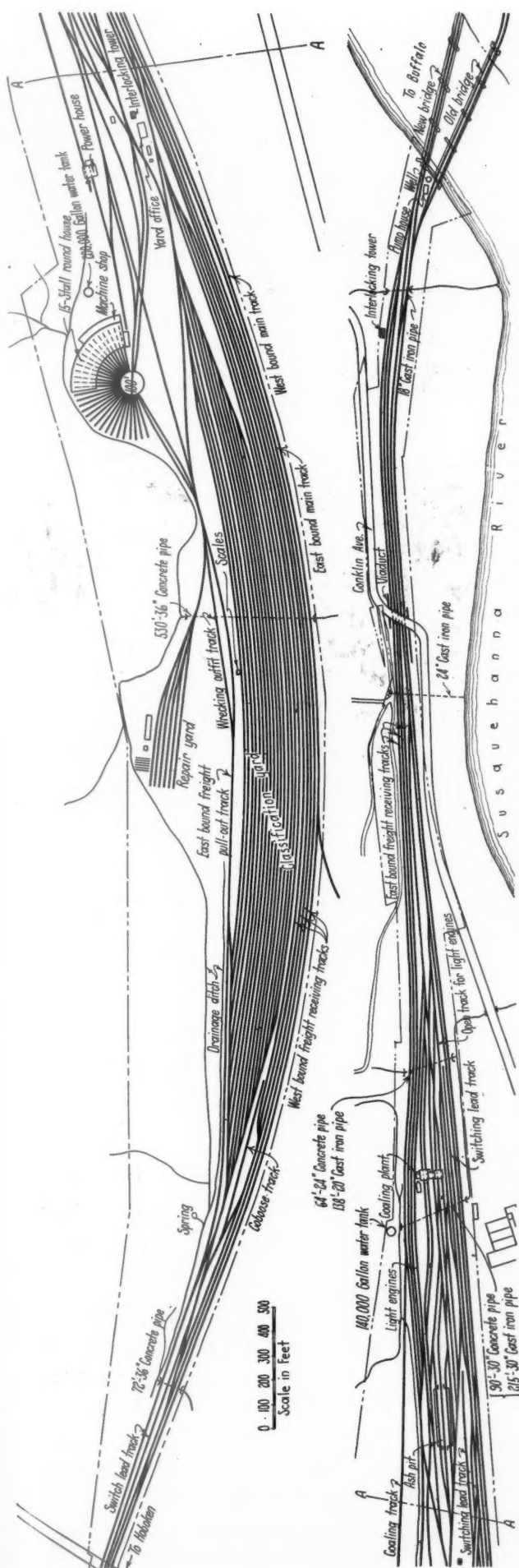
Referring to the drawing showing the layout of the classification yard and engine terminal, the yard consists of three westbound receiving tracks and three eastbound receiving tracks, with a total capacity of 607 cars, 17 classification tracks with a total capacity of 1,288 cars, a

scale track and six repair tracks, besides the tracks to the coaling station, ash pit, enginehouse, power house and store room.

The enginehouse is located on the south side of the yard and has 15 stalls each having a length of 105 ft. In addition 16 tracks are provided outside the building, leading from the turntable, which have a storage capacity for 34 locomotives. The enginehouse is of reinforced concrete construction with a creosoted plank roof covered with slag roofing. The floor is three-inch wood blocks placed directly on a concrete base. Exceptional provisions have been made for natural lighting. The windows in the back circular wall and the monitor section of the roof are continuous between the columns, while the end of the building opposite the master mechanic's office is occupied almost entirely by windows. Four 200-watt drop lights located between engine pits, one light in each bay, furnish illumination at night. The engine pits are 82½ ft. long by 4 ft. wide. A pitfall of concrete is built at the end of each pit to stop any undesired movement of the locomotive toward the outside wall. It is covered with planks sufficiently light to permit the wheels to break through, thus stopping the locomotive. The smoke jacks are of cast iron.

The master mechanic's and general foreman's office, store rooms, boiler washout room, and a small machine shop are located at the end and around the outside circular wall, forming a part of the structure.

The enginehouse and adjacent rooms are heated by air drawn through steam-heated radiators and forced by fans through underground concrete ducts to three openings in the engine pits and to openings in the various rooms. The foul air escapes through openings located just under the roof. The capacity of the system provides for six complete changes of air per hour and also



point locomotives are cut off from their trains and taken to the terminal for coal and water, after which they are again coupled to the trains to continue on to their destination. All this work is handled by a force of 103 men, including the supervisory and clerical forces, of which 45 work on the first shift, 27 on the second and 31 on the third.

Referring to the drawing of the classification yard and engine terminal, incoming locomotives are brought into the engine terminal via the two running tracks leading across the yard from south of the yard office to the turntable, where they are spotted by the engine crew in front of the general foreman's office, which is located in the same section of the enginehouse building as the office of the master mechanic. Each engineman makes his usual inspection and turns in his work report at the general foreman's office. All tools are removed from the locomotive on arrival and are checked in the engineman's register book. Each tool is inspected, placed in condition for service, tagged and placed in a tool room provided for that purpose. A tag on the tool shows the

in the register room to see that part of the board with which he is concerned.

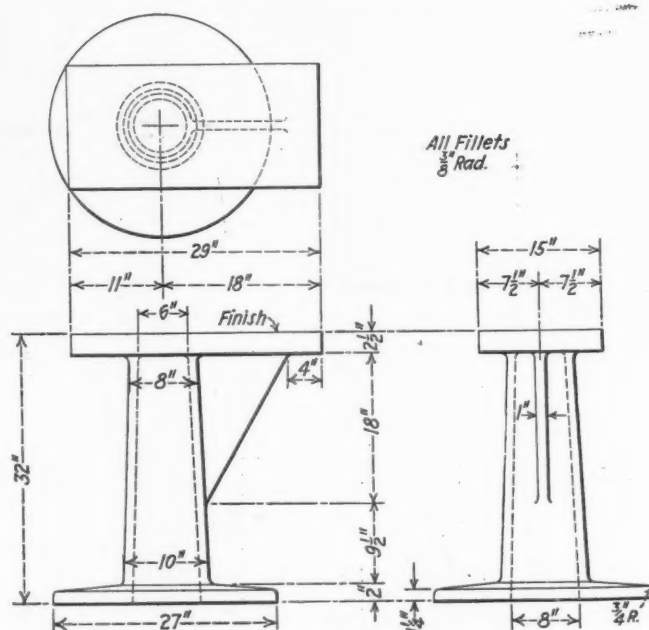
Upon completion of the engineman's inspection and the making out of his work report, the locomotive is taken by a hostler to the coaling station, which is located at the west end of the yard. At this point the sand box is replenished and the tender is filled with coal and water. The coaling station is of the mechanical type, with a



The crew board is built in the form of a cylinder which revolves in an opening in the partition wall between the register room and the general foreman's office

number of the locomotive from which it was removed. This work of storing, removing and replacing tools is in charge of one man, who also does the work of filling the grease cups and lubricators.

A feature of the engine crew's register room is the revolving crew board shown in one of the illustrations. This board is located in the general foreman's office and is mounted on two pivot bearings secured to the floor and ceiling, respectively. It revolves in a window cut in the partition wall between the office and the register room. The board is laid out in the usual manner, spaces being provided for regular and extra crews, etc. It can be revolved from either side of the partition, which facilitates marking up the board on the part of the engine dispatcher's clerk, and it can be readily turned by any one

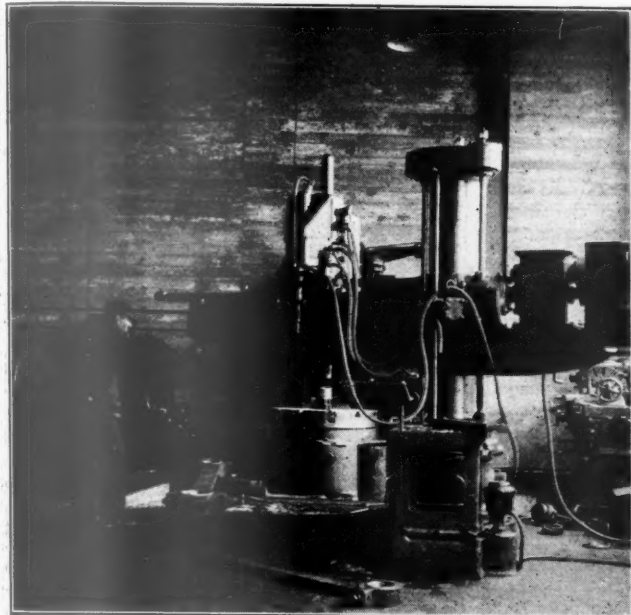


Cast iron vice bench used on the erecting floor and in the machine shop of the enginehouse

capacity of 600 tons, serving four tracks. The storage bin is provided with eight pockets. The sand is supplied from a sand hopper having a capacity of 20 tons, built into the coaling plant.

The water ash pit type serves two tracks. This pit, which is an old facility, was originally 140 ft. long, but

has been extended to a length of 240 ft., which provides a capacity for eight locomotives, four on each track. The cinders are removed from the pit and loaded into cars, spotted on a track between the two pit tracks, by an electrically operated gantry crane equipped with a clam shell bucket. The pits are covered with sectional



The machine shop

gratings made of angle iron to serve as a platform for the fire cleaners and to provide protection for the men working around the pits. These gratings can be re-

enginehouse foreman give the locomotive a careful inspection, noting all defects on the locomotive inspection report. The engineman's work reports, which have been made against the locomotive during the past 30 days, are carefully examined to determine what work has been reported but not performed. The enginehouse foreman then determines the work to be done at that time.

No Class 5 repairs are made at this terminal. An average of 35 boiler-wash certificates are filed every 30 days and, in addition to work of this nature, the enginehouse forces also do considerable welding and boiler patch work. The enginehouse is well equipped with both gas and electric welding facilities to make repairs to the running gear, frames, boiler or tender. A portable Westinghouse electric welder is included in the equipment, and service outlets for this welder have been placed at alternate stalls. Two engine truck drop pits and two driving wheel drop pits with individual telescoping pneumatic jacks are installed and the larger pits are so constructed that trailer truck and tender wheels may be removed on them when desired. One of the pits is provided with a bent rail, on which locomotives are placed requiring spring repairs or renewals. Chain hoists are located at strategic points between the pits for use in air compressor and repair work of similar nature.

Shown in one of the illustrations is a cast iron vice bench, a number of which are placed at convenient points in the enginehouse. Benches of this design are in service in practically all the shops and enginehouses of the Lackawanna.

The machine shop

The machine shop is equipped with all the machine tools necessary to maintain the locomotives assigned to the Syracuse and Utica division in all except general repairs, which are made at the system shops at Scranton,



Ample provisions have been made for natural light in the enginehouse

moved, or replaced by the gantry crane when the cinders are taken from the pits. Flexible operation to and from the pit is afforded by switches and crossovers.

Inspection is made in the enginehouse

After the fires are cleaned the locomotive is taken direct to the enginehouse. Here the inspector and en-

Pa. The following is a list of the machine tool equipment:

- 1 20-in. by 10-ft. Springfield engine lathe
- 1 Columbia 32-in. heavy duty back geared crank shaper
- 1 Acme triple head bolt cutter, V-3 type
- 1 60-in. Dress multi-duty ball bearing radial drill
- 1 Bridgeport No. 6 a. c. motor driven floor grinder
- 1 Oblong babbitt furnace and melting pot, with one No. 533 suction type burner complete with register.

- 2 One-ton Motorbloc chain hoists electrically operated with suitable motor and control arrangement for a. c. current of 440 volts
 1 50-ton Chambersburg hydro-pneumatic forcing bushing and bending press, 36 in., between columns, 18 in. stroke, 42 in. maximum distance bed to ram at top of stroke, fitted with a 16-in. circular opening in the bed, and equipped with a crane and trolley.

A small tool room is located in a corner of the machine shop, from which all small hand tools are issued by a check system. The racks installed in the tool room are similar in many respects to the display racks used by automobile dealers for the display of parts. Each tool is assigned a certain place on the rack, which is stenciled to show the identity of the tool in each space. A hook on which to hang checks is also provided at each space.

The power house

The power house is a three-story brick and steel structure with a brick stack 120 ft. high and is located west of the enginehouse, as shown in the plan drawing. Coal is received in carloads on the third floor and dumped into hoppers on the second floor, from where it is conveyed to the boilers.

The entire second floor, which contains practically all of the power plant equipment, is divided into two principal rooms. The boiler room contains two Erie City vertical two-drum water tube boilers of 285 hp. each. They are fitted with high and low water alarms, automatic dampers, stationary grates of the Parsons type and are operated by forced draft. Feed water is heated by a Cochrane feedwater heater, measured and supplied to the boilers by two 7-in. by 4½-in. by 10 in. Worthington inside plunger packed pumps. A feed water regulator of the Copes type maintains a constant level of water in the boilers at all times. When necessary to clean the fire, plates of the removable type located just inside each firedoor are lifted, the ashes are pulled back and dropped through openings into a hopper, from which they fall by gravity to ash cars located in the basement of the power plant.

The engineroom contains a cross compound two-stage Ingersoll-Rand air compressor. Other equipment in the

engine room includes a large draft fan driven by a Troy horizontal engine, a motor driven centrifugal fire pump, a single phase 6-kw. 440-volt a.c. generator, driven by a Troy automatic vertical engine. This generator is



Interior view showing the planked pitfall placed at the end of the track in each stall

used only in the event of failure of power from the local power plant from which the railroad company purchases its electrical energy.

Machine versus hand forging

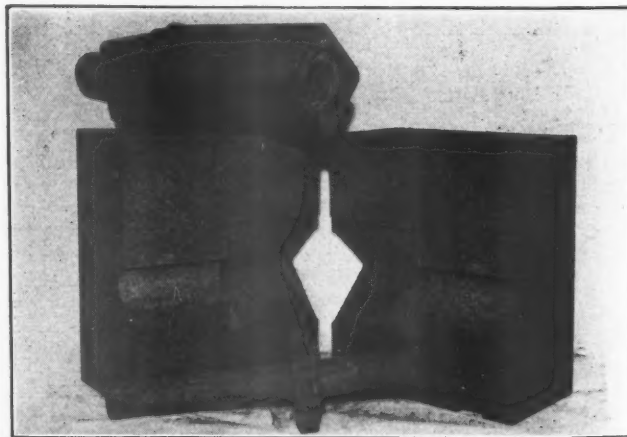
A comparison of the relative costs of nine typical forging machine operations at C. & N. W. shops

THE Chicago & North Western is equipped at its Fortieth avenue shops, Chicago, to handle practically every kind of a forging machine job common to railroad practice and has repeatedly demonstrated the economy possible by machine forging over hand forging methods. Quality forgings are produced in less time, at less cost and in large or small quantities, depending on the need. A description of nine typical operations is afforded in the following article which gives the estimated costs of forging by hand and on modern Ajax forging machines.

Link pin for trailer spring.—Manufactured out of 3-in. round wrought iron. Three upsets are required for gathering the stock by moving the material forward in the die approximately 4 in. at each upset. Another heat is required at this time to complete the forging, the flange of which, when finished, is 7 in. square by 1½ in. thick. Ten forgings are made in eight hours by one blacksmith, one helper and one heater.

Labor cost per forging (by machine).....	\$1.73
Labor cost per forging (hand forged).....	11.48

Motion work bushing.—manufactured out of 2½ in. round mild steel in two operations. At the first opera-



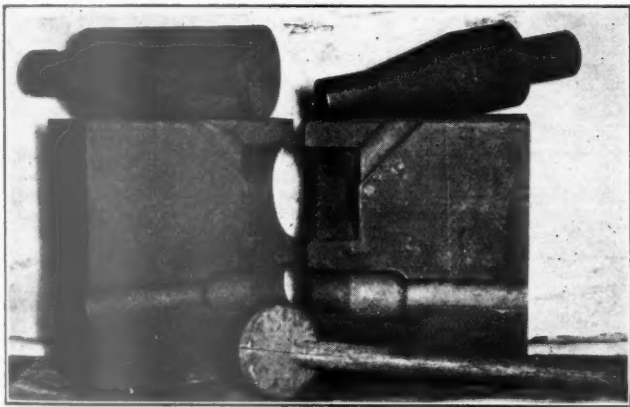
Dies for making trailer spring link pins on a 6-in. Ajax forging machine

tion in the lower part of the die, the stock is gathered. The cavity of this operation is $\frac{1}{16}$ in. smaller in diameter than the cavity for the second operation so that the stock will enter freely into the latter. The gripper die



Dies for forging motion work bushings on a 4-in. machine

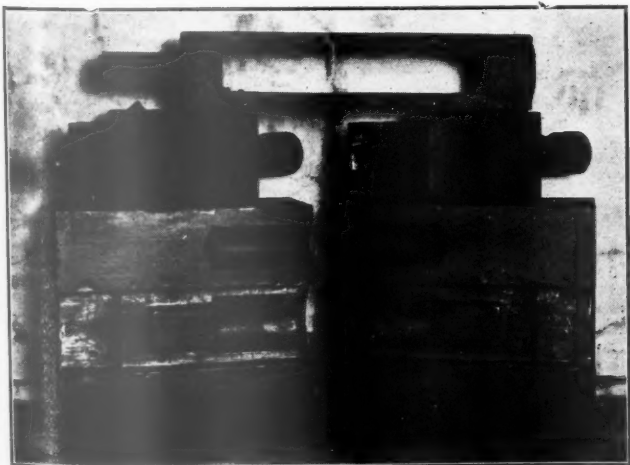
at the second operation is bored $\frac{1}{8}$ in. larger than the material used. When the header at the second operation completes its forward stroke, punching the hole, the bar stock is forced back eliminating all waste of mate-



Smoke box braces, top end, are forged on a 6-in. machine

rial. One hundred and seventy-five bushings are made in eight hours by one blacksmith and one helper.

Labor cost per forging (by machine).....	\$0.08
Labor cost per forging (hand forged).....	0.92

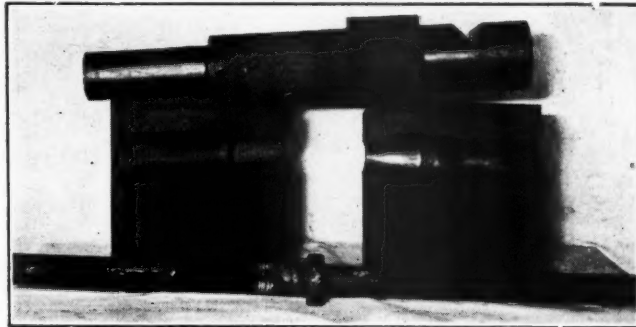


Dies used on 6-in. machine for forging a main driver brake pull rod, slotted end

Smokebox brace (top end).—Manufactured out of $2\frac{1}{2}$ -in. round wrought iron in two operations. After the stock is gathered at the first operation the material is bent (next to the boss) to an angle of approximately 20 deg. in order to have the stock centrally located in the cavity of the die at the second operation when applied there. Twenty braces are made in eight hours by one blacksmith and one helper.

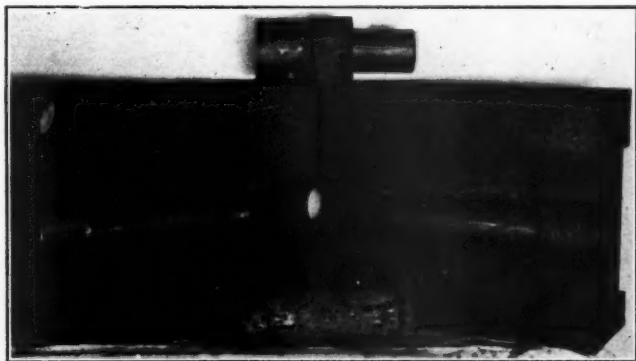
Labor cost per forging (by machine).....	\$0.76
Labor cost per forging (hand forged).....	7.51

Driver brake pull rod (slotted end).—Manufactured out of wrought iron stock, 1 in. thick by $2\frac{1}{2}$ in. wide, cut to the proper length and offset $\frac{1}{2}$ in. at one end 6 in. long. Stock $2\frac{1}{2}$ in. square and 7 in. long is placed



Valve stems are forged on a 6-in. machine

between the two pieces of the 1-in. by $2\frac{1}{2}$ -in. stock at the offset end. After welding these under the auxiliary press of the machine, the forging is swedged at the end to $2\frac{1}{4}$ in. round, 7 in. long. Another heat is taken and the stock applied to the dies; the header for this operation is bored to admit the $2\frac{1}{4}$ in. round stock, finishing this end of the forging at the completion of its forward stroke. Another piece of $2\frac{1}{2}$ -in. square stock 6 in. long is placed between the sides of the forging at the opposite end; another heat is taken and the forging ap-



Draw bar pins are forged in one operation on a 6-in. machine

plied to the gripper dies, which have been turned end for end, and another header applied to the crosshead which finishes the forging at the completion of the stroke. Eight pull rod forgings are made in eight hours by one blacksmith, one helper and one heater.

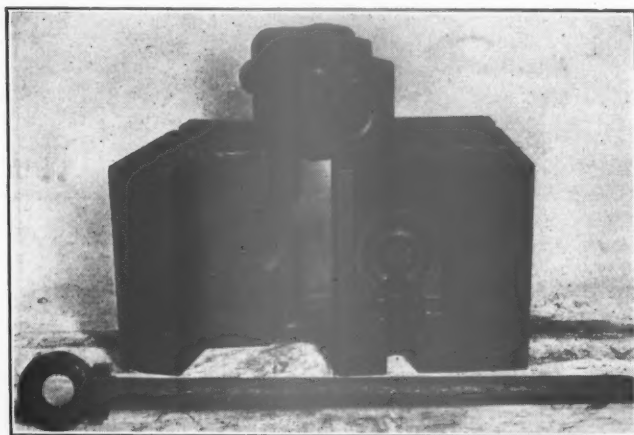
Labor cost per forging (by machine).....	\$2.63
Labor cost per forging (hand forged).....	10.00

Valve stem forging.—Manufactured out of $2\frac{1}{2}$ -in. round mild steel in one operation. The valve stem forgings are $2\frac{1}{2}$ in. in diameter by 56 in. long, with a 1-in. by $4\frac{1}{2}$ in. diameter collar, upset at the center of the stock. The header is bored $2\frac{5}{8}$ in. diameter, deep enough to admit stock to where the collar is to be formed on the

valve stem, and where a heat is taken on the material. The stock is gripped in the die and held from slipping back, in connection with a backstop. The opposite end of the stock is entered in the hole of the header, and as this performs its forward stroke, the stock comes in contact at the bottom of the hole in the header, upsetting material and forming a collar in the cavity of die when the header completes its forward stroke. Twenty valve stems are made in eight hours by one blacksmith and one helper.

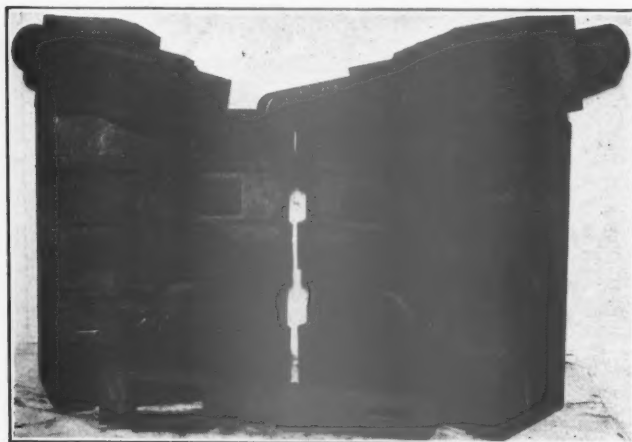
Labor cost per forging (by machine)..... \$0.76
Labor cost per forging (hand forged)..... 3.76

Drawbar pin—Manufactured out of $3\frac{3}{4}$ in. diameter engine bolt iron and made in one operation. The fin-



Safety chain eye-bolt and dies used on a $2\frac{1}{2}$ -in. machine

ished pins are 4 in. in diameter by 17 in. long. Stock is cut to the proper length to allow for upset of the head and body of the pin. After heating the stock its full length and applying it to pins extending out of the dead die, the stock is forced into the cavity as the dies are set in motion. The header in performing its forward stroke upsets the stock, forms the head, and points the



Dies used in forging a trailer truck spring hanger

end of the pin. Eighty pins are made in eight hours, by one blacksmith, one helper and one heater.

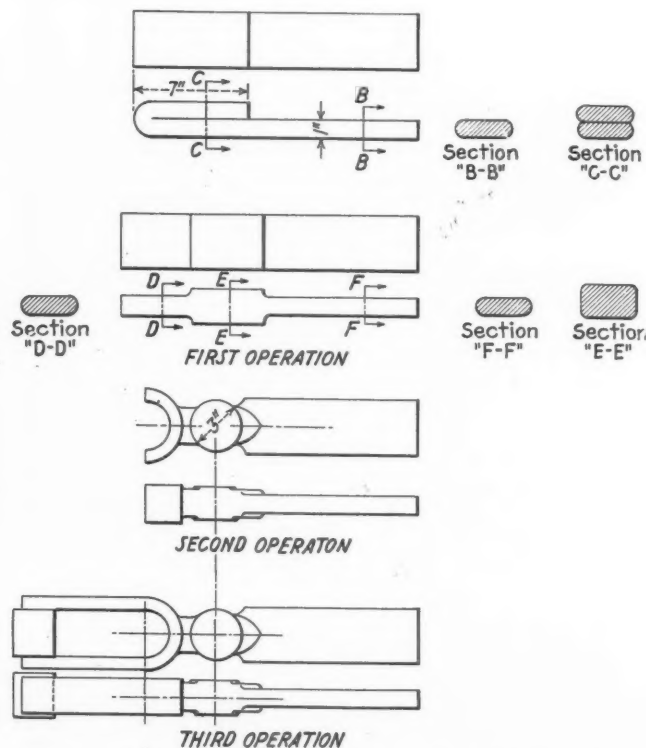
Labor cost per forging (by machine)..... \$0.27
Labor cost per forging (hand forged)..... 2.44

Safety chain eye-bolt—Manufactured out of $2\frac{1}{4}$ in. diameter wrought iron in four operations. At the first operation the collar is formed, the header for this operation being bored to admit stock ahead of the collar. This stock is upset at the second operation to a ball, which is

flattened and punched at the third operation between the gripper dies. At the fourth operation, the forging is finished at the front of the gripper die in connection with the header. Fifty eye-bolts are made in eight hours by one blacksmith and one helper.

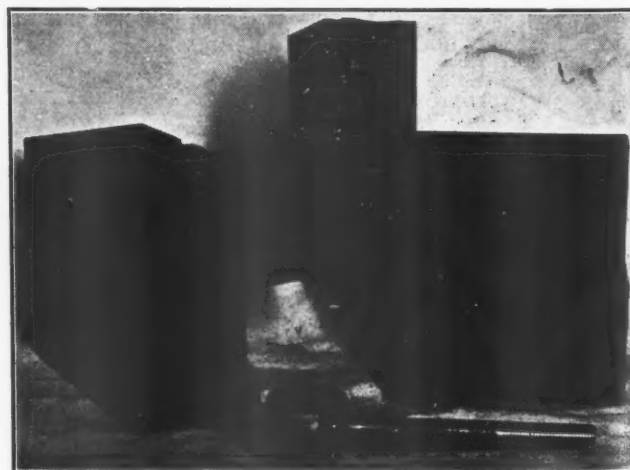
Labor cost per forging (by machine)..... \$0.28
Labor cost per forging (hand forged)..... 1.40

Truck trailer spring hanger—Manufactured out of 1 in. by $3\frac{1}{2}$ in. round edge iron. The material is cut to



Operations in a forging trailer truck spring hanger

the proper length and bent double 7 in. long at one end, then being swaged (under auxiliary press) back of the double material, to the shape indicated at "first operation" on the drawing. This stock is applied to the lower



Bell clapper eye-bolts are forged in three operations on a $1\frac{1}{2}$ -in. machine

pass in the forging machine dies where a ball is formed and part of the slotted end, as shown at "second operation" on the drawing. Two pieces of $\frac{3}{4}$ -in. by $2\frac{1}{2}$ -in. iron are cut to the proper length and placed on each side

of the partly formed slotted end and a piece of $2\frac{1}{2}$ -in. square iron is laid between the forks on the opposite end, as shown at "third operation." A welding heat is taken on the material which is applied to the upper die pass and in connection with the header the forging is finished at this end. Another set of dies and header are required for finishing the opposite end of the forging which punches the slot and cuts the material to the proper radius. Eight forgings are made in eight hours by one blacksmith, one helper and one heater.

Labor cost per forging (by machine).....	\$2.63
Labor cost per forging (hand forged).....	9.44

Eye-bolt for bell clapper—Manufactured out of $\frac{7}{8}$ -in. diameter wrought iron. The stock is gathered by doubling the material 3 in. at one end and upsetting it at the first operation to 1 in. thick, $2\frac{1}{2}$ in. wide and 3 in. long. At the second operation, the hole is punched and the forging partly formed between gripper dies. It is finished at the third operation at the front of the gripper die in connection with the header. Fifty forgings are made in eight hours by one blacksmith and one blacksmith helper.

Labor cost per forging (by machine).....	\$0.28
Labor cost per forging (hand forged).....	1.43

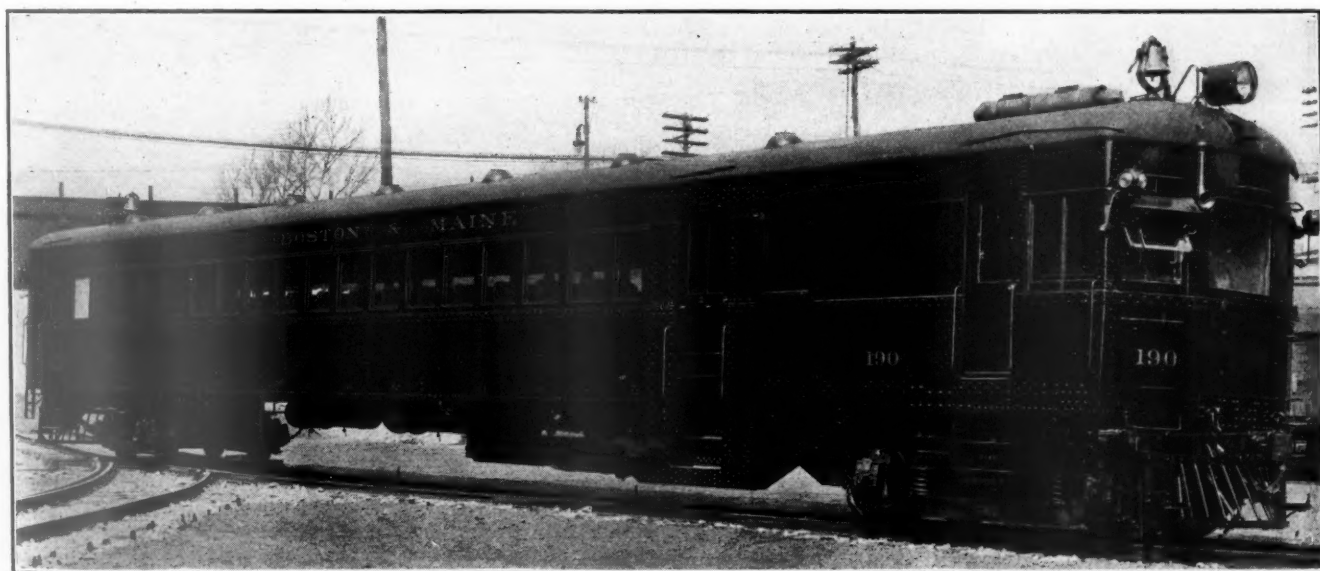
Motor rail car service on B. & M.

Each car in operation receives daily 4 hrs. service attention from locomotive mechanics especially trained for this class of work

MOTOR rail cars on the Boston & Maine operate over approximately 60 per cent of the total route mileage. They run on routes in Massachusetts, from Boston to Springfield, Fitchburg, Lawrence and Marlboro and to Portsmouth, N. H., also between Salem and Lowell. They operate over two routes between Worcester, Mass., and Concord, N. H., while in New Hampshire several branch lines are served from Concord, Manchester, Plymouth, Rochester and Milford. There

most of their runs. Electric drive is provided for 16 of the cars and mechanical drive for the remaining eight cars. Eight of the cars are heated with forced hot air and the remaining 16 with hot water. All of the cars, except one, are provided with baggage compartments. One car has a baggage capacity for 1,000 lb., seven cars for 2,000 lb. and the remainder for 3,000 lb.

The trailer capacity is dependent on the capacity of the power unit. Six of the cars require a special trailer



A special B. & M. design of Brill rail motor car which has no baggage compartment

is also local motor car service on main lines out of Springfield, Mass., between North Adams, Mass., and Troy, N. Y., and between Concord, N. H. and White River Junction, Vt.

The equipment

Pertinent information concerning these cars is listed in the table. Three of the cars are equipped with 175-hp. motors, six with 190-hp. motors, one with a 225-hp. motor, three with 250-hp. motors and ten with 275-hp. motors. Only one car is equipped with a 75-hp. motor. This car does not pull a trailer while all the others do on

or a light weight coach and will handle a trailing load of from 18 to 20 tons. All of the other cars will handle a trailer load of 35 tons or less.

Operation

A little over a year ago the B. & M. decided to use motor rail cars to replace steam operation on some branch lines and to improve local train service by operating additional trains. Only gasoline is now used as a fuel.

When the cars were put into service, the reaction of the traveling public toward them was carefully studied.

for the co-operation of their respective departments for the proper maintenance of these units. The superintendent of locomotive maintenance has under his jurisdiction a supervisor of rail motor car maintenance with one assistant, whose duties are to supervise repairs and maintain inspection.

After these cars were in service for a short time it was necessary to have located, at each terminal point, one or more mechanics trained to make repairs to a gasoline engine. Consideration was first given to employ automobile mechanics who had received their training at outside garages. Acting on the advice of the manufacturers, the idea was abandoned for the reason that professional auto-mechanics invariably take the attitude that they know everything there is to be known about repairing a gasoline engine and, consequently, are difficult to supervise. So it was finally decided to recruit the mechanics from the shop forces. These men were carefully selected and then put through a period of training under the supervision of the service men sent to the shops by the motor car manufacturers.

The mechanics are located at each terminal where the cars lay over. Each car receives the attention of at least one mechanic at each lay-over period. If two cars lay over at a terminal, one man can handle both as an average of only four hours per car per day is required for

month. This form shows at a glance the daily performance of each car.

The problem of spare parts

As the cars were put into service, a stock of spare parts as recommended by the builders was purchased. In spite of efforts to provide a balanced stock of spare parts certain items have proved unnecessary, while others have been in active demand. However, in general, the suggestions received from the manufacturers relative both to spare parts and to maintenance, have been very helpful. As the B. & M. places the revenue earning value of the cars at from \$50 to \$100 a day, it takes the attitude that it is better to be on the safe side with its stock of spare parts rather than to lose service time while awaiting a factory shipment.

When attempting to analyze the operating expense figures for these cars, consideration must be given to such factors as the comparative expense of operating steam trains in the same service, the character of the road, number of miles made by each car, as they affect the service of each car and hence the significance of general averages is very limited. A general indication of the cost of the motor car service, however, may be gained from the fact that the expense for the operation and maintenance of 13 cars for the 10 months ending Dec.



This electro motive design of rail motor car makes 183 miles every day in service

their maintenance. In case of emergency, the supervisor and his assistant are available for inspecting, locating troubles and assisting at outlying points where a one-man terminal needs additional help.

In order to have a record of the mechanical performance of each car, several reports are filled out by those responsible for maintenance. The weekly work report, shown in one of the illustrations, contains a list of all of the principal parts which are subjected to wear and repair. At the end of each day's run, these parts are inspected by the mechanic who notes their condition in the report. The car operator also turns in a work report which aids the mechanic to locate trouble. If a part is found defective and not repaired, a zero mark is made in the corresponding square. The reason for failure to make repairs to a defective part is noted on the back of the report. These reports must be in the hands of the supervisor of rail motor car maintenance not later than Monday of each week.

Daily, each car is reported to the mechanical department, by telegraph, whether or not each car is on its run and if not, why not. The man assigned to receive these reports lists the information on a form called the "performance of motor cars." The numbers of cars are listed along the left side of the report, and across the top 31 columns are provided, representing the days of the

31, 1926, averaged 49 cents per train mile. This figure includes only the direct charges for operation and repairs and does not include the carrying charges. This figure is comparable with the cost per train-mile in steam service as the indirect charges are not included in the final figure. The carrying charges, which include depreciation, insurance and interest, ranges approximately from 11 cents to 19 cents per train-mile, depending on the value of the car and the number of miles it makes during the month. During the week of March 24, 19 motor cars were in service, making 14,571 train-miles and with their trailers, 25,375 car-miles. They used 11,201 gals. gasoline. This is an average of 1.3 train-miles per gallon of fuel, which average has been maintained during the preceding 12 weeks.

PITTSBURGH & WEST VIRGINIA.—A contract has been awarded to the T. J. Foley Construction Co., of Pittsburgh, Pa., for the construction of a machine shop at Rook, Pa., which is estimated at a cost of \$150,000.

CHICAGO, INDIANAPOLIS & LOUISVILLE.—A contract for the construction of a brick and structural steel locomotive repair shop at Lafayette, Ind., has been let to A. E. Kemmerer, Lafayette. The shop, which is expected to cost about \$275,000, will contain 15 locomotive pits, two 15-ton cranes, and one 210-ton bridge crane.

American Welding Society meets at New York

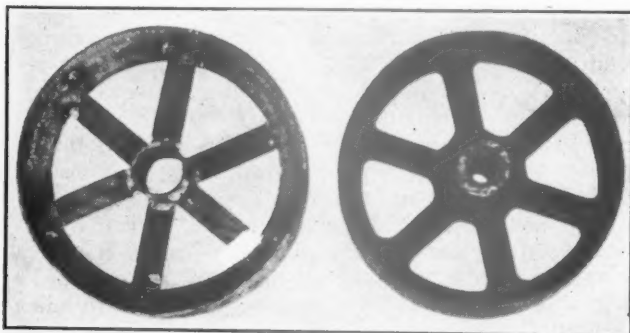
Technical papers furnished much information of interest to railroads—Co-operation keynote of presidential address

THE annual spring meeting of the American Welding Society was held at the Engineering Societies building, New York, April 27, 28 and 29, 1927. There were approximately one hundred fifty members, guests and supply men registered. The morning session of the first day was devoted to the presentation and discussion of committee reports on gas and electric arc welding and pressure vessels. The afternoon session was devoted to a review of the progress made by the various research committees of the American Bureau of Welding, and plans were made for future investigation activities.

A symposium of research activities

The Thursday morning and afternoon sessions were given over to the presentation and discussion of technical papers. At the morning session ten papers were read which formed a symposium of the research activities in the welding field during the past three years. C. A. McCune, chairman of the Welding Wire Specifications Committee, started with a paper setting forth the thoroughness with which welding rods, irrespective of make, are tested for physical and chemical properties. He pointed out that the committee welcomed the opportunity to examine welding wire which had been bought to weld a particular base metal, but was found to give unsatisfactory results. Mr. McCune mentioned a case, in particular, where welding wire had failed to give certain results, and how the trouble was located by a microscopic analysis.

J. H. Deppeler of the Metal & Thermit Corporation, presented a comprehensive picture of the research ac-

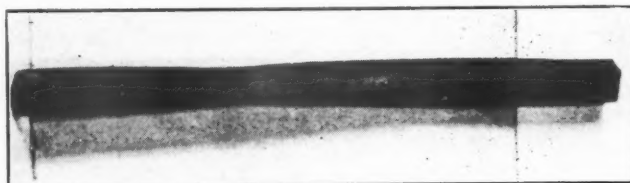


At the left a welded steel shop truck wheel and at the right a cast wheel

tivities for the development of the Thermit process of welding. He pointed out that the result of this constant research is that Thermit steels which twenty years ago were not uniform, the fractures of which would show large crystal faces and a maximum tensile strength of about 50,000 lb. per sq. in., with low ductility, are now almost perfectly uniform with fine grain structure, with tensile strength of 70,000 lb. per sq. in. over, and ductility which will allow for any amount of forging, bending and deformation. Mr. Deppeler stated further that welding technique has been greatly developed and simplified not only reducing to a minimum weld failures,

but also, within the last five years, reducing the cost of making a Thermit weld by half.

R. R. Moore of the Physical Testing Branch of the United States Air Service read a most interesting paper on the fatigue of welds. Mr. Moore pointed out, in his opening remarks, in that very little attention has been given to the effect of repeated stresses on the life (fatigue) of welded joints. His paper described tests made to tubes subjected to vibrations, such as those used



Twisted Thermit welded specimen

in the fuselage on an aeroplane and in a locomotive boiler. The tests described cover welds made by the gas, electric arc and atomic hydrogen processes. His paper described the methods of making the tests, testing equipment used, samples of fatigue specimens used for testing, photographs of the types of fatigue fractures resulting with different welding processes and grades of base metal and also tables and charts showing the test data obtained. Many microphotographs were used to show the condition of the metal in the welded zone. Mr. Moore summarized the results in these words:

"Although the tensile efficiency of the welded tubes was better than 75 per cent, the fatigue strength was as low as 13 per cent and never higher than 35 per cent of the tensile strength of the weld. Poor fusion has a drastic effect upon the resistance of the weld to repeated stresses. Poor fusion may not be detected by the tension test, but is detected by the fatigue test.

"The 1/2-in. diameter welded tubes showed a better resistance to fatigue than the 1-in. diameter tubes, probably because they can be welded more uniformly.

"The endurance limit developed by specimens from solid deposits of welding could not be equaled by the welded tubes. This is probably due to a difference in structure caused by the more rapid cooling of the relatively thin weld metal joining the tubes. The deposited gas weld showed an endurance ratio as good as found on most steels. The deposited arc weld and atomic hydrogen weld were somewhat lower.

"The 'piling up' of the weld may operate to lower the resistance to repeated stresses due to locally intensified stresses set up by the sudden change in cross section.

"Long time fatigue tests show that the deposited metal has a definite endurance limit just as is found in steels."

James W. Owens, director of welding, Newport News Shipbuilding & Dry Dock Company, read a paper describing the research activities of his company during 1926. His paper made mention of tests of particular interest to the railway welders. Under the subject of gas welding, Mr. Owens described a test to determine the strength of Tobin and manganese bronze welds in cast iron. The reason for making this test was to obtain per-

mission of one of the customers of his company to use Tobin bronze filler metal instead of cast iron filler metal in the repair of defective castings so as to eliminate or reduce preheating to a minimum, thereby reducing the time and cost of welding and of cracking a casting.

The test procedure followed out was to fill a double vee butt joint welded with 1½-in. diameter cast iron rods, specially poured in the foundry and also to make Tobin and manganese bronze welds. The test results showed that such welded joints have a high strength and in all cases are higher than that of the base metal.

Test of cast iron specimens welded with the gas torch using Tobin and manganese bronze filler metal

Specimen	Elastic limit (lb. per sq. in.)	Ultimate strength (lb. per sq. in.)	Location of fracture.
Base metal	14,220	18,260
Tobin bronze weld....	18,910	18,910	Base metal 1 in. from center line of weld.
Tobin bronze weld....	18,800	18,800	In fusion zone.
Manganese bronze weld	18,680	18,680	Base metal 1 in. from center line of weld.

Metal arc welding test

Another interesting test made under Mr. Owens' supervision was to determine whether fillet welds made by the metal arc will not pull the faying surfaces of lap joints in intimate contact, and, if not, to what extent.

The object of the test was to prove that it was not necessary to pull the faying surfaces of metal arc welded lap joints as close together, prior to welding, as required for riveted joints.

Strips of metal 2 in. wide, ⅜ in., ½ in. and 1 in. thick were welded on 6 in. and 12 in. channel sections.

Mr. Owens stated that the results of this test showed that intermittent and continuous fillet welds will progressively pull the faying surfaces of a joint together. An intermittent fillet weld pulls them together approximately .005 in. per linear inch of joint, as shown by a ⅜-in. weld, and a continuous fillet weld approximately .012 in. per inch welded, as shown by ½-in. and 1-in. welds. A second layer compresses the first layer of a continuous fillet weld approximately .0003 in. per linear inch welded, thus further pulling together the faying surfaces this amount. The maximum pulling together of the faying surfaces is effected by the first layer of the fillet weld.

Torsional stresses of Thermit weld

Another test made by Mr. Owens, of particular interest to the railroads, was to prove that a Thermit weld will satisfactorily resist torsional stresses. Two pieces of medium steel 2 in. square and 18 in. long were Thermit welded and twisted in a lathe as shown in the illustration. The test proved that a regular Thermit weld will satisfactorily resist torsional stresses without reinforcement.

R. B. Fehr of the Una Welding & Bonding Company, outlined the research activities of his company, which, among other things, included the development of a direct current railway welder, of welding rods and of bonds and bonding processes. The research on welding rods was devoted to the physical and chemical properties of uncoated and coated rods and the adaptability of various rods to different welding problems.

Mr. Fehr stated that the study of bonds and bonding processes included the fatigue properties of rail bonds; the application to various parts of the rail; the electrical resistance of copper to steel welded bonds; the effect on the rail; a study of the junction of copper to steel welds and applying rail bonds by the gas welding process. Mr. Fehr's paper was supplemented by a series of slides showing views taken in the laboratory and on railway property.

The paper read by D. H. Deyoe of the General Electric Company covered some of the developments and research made by his company. Of particular interest to

the railroads are the developments made in automatic arc welding, especially an automatic machine developed for building up worn car wheel flanges. Mr. Deyoe mentioned that an automatic welding and clamping machine has been developed for the welding and handling of parts making up a completed steel tie made from scrap rails and angle plates. These ties have been tested out on the Delaware & Hudson for over a year with the result that the D. & H. has decided to undertake the substitution of metal for wood ties in its yards and sidings.

Replacing castings with welded steel parts

J. F. Lincoln of the Lincoln Electric Company read a paper on the problem of replacing castings with welded steel parts, a new application of welding which will eventually effect the costs and strength of many machines and structures. The fundamental principles involved in this problem, as pointed out by Mr. Lincoln, are:

Cast iron has a tensile strength of about 10,000 lb. per sq. in.
Welded steel has a tensile strength of approximately 50,000 lb.
Cast iron has a modulus of elasticity of 12,000,000.
Steel has a modulus of elasticity of 30,000,000.
Castings have an average cost per pound of six cents.
Rolled steel has an average cost per pound of two cents.
The factor of safety necessary for the same degree of safety will be half as great with steel as with cast iron.

Mr. Lincoln deviated a little from the subject of his paper and commented on the differences of opinion as to welding a stationary boiler and a locomotive boiler. Mr. Lincoln said: "A rather unique point of view on this subject is shown in the locomotive. The Interstate Commerce Commission allows very wide latitude in the case of arc welding on locomotives and there is practically no locomotive in existence at the present time which has not a very considerable amount of arc welding used both in its manufacture and repair. As is well known, it carries 200 lb. steam pressure; is hand fired, and is racked over the rails at 60 miles per hour. Yet under these conditions very few cases of failure of welds in a locomotive have ever occurred, and arc welding has, in the opinion of many railroad companies, increased enormously the amount of time that a locomotive can be kept outside of the repair shop. Yet, this same locomotive boiler, if removed from the rails, put on a brick foundation, automatically stoker fed and run at 16 lb. pressure, would insure the owner being put in jail."

Mr. Lincoln also pointed out that arc welding is eliminated by law from a tank car, but specified for the tank into which the contents of the tank car is emptied.

Specific recommendations made in the presidential address

The annual dinner of the American Welding Society was held Thursday evening at the Hotel Commodore. F. H. Farmer, who was re-elected president of the society, made an address in which he made some specific recommendations as to the future activities of the American Welding Society. Mr. Farmer pointed out that it would be an ideal condition if the society could devise a plan whereby it could license welding operators, but owing to the many obstacles to be overcome, this idea cannot be carried out at the present time. He suggested as an alternative that the society could prepare a set of rigid examinations for welders which they would have to pass before being accepted as first-class operators. He carried the thought still further by suggesting that a thorough training course could be worked out by the society and distributed to those companies employing welders. In Mr. Farmer's opinion it is the duty of the society to furnish the users of welding equipment expert advice and correct information on any problem pertaining to welding. This service should be continued until trained welding engineers are available.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Who can answer this question?

WORCESTER, Mass.

TO THE EDITOR:

Here is a question I would like to have answered in the columns of your magazine.

Can a 1¼-in. by 5-in. riveted wrought steel yoke be substituted for a cast iron cross-key yoke without issuing a defect card for applying a wrong yoke, whether or not the car is stenciled for a cross-key yoke? Could this be considered wrong repairs? Does A.R.A. Rule No. 17 cover this item?

A READER.

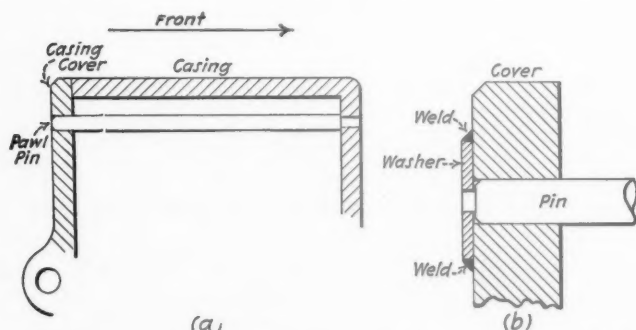
Applying conveyor pawl pins to Duplex stokers

SOLDIER SUMMIT, Utah.

TO THE EDITOR:

Having read many interesting and helpful articles in the *Railway Mechanical Engineer*, I thought that the following idea dealing with the application of conveyor pawl pins to Duplex stokers might be of interest to some other reader.

We have had to cut out several locomotives at this point on account of a stoker failure caused by broken conveyor pawl pins. Owing to the position of the stoker



Sketch showing the method of applying conveyor pawl pins to Duplex stokers

on the engine relative to other appliances, this job took from five to eight hours to complete. The following method was worked out which makes it possible to do this job in at least one hour, and on one occasion it was done in 40 minutes. This job is performed as follows:

Disconnect the drive shaft universal joint and mark the pin hole or holes where the pins are broken. Then remove the pawl casing cover and pawls, and throw the conveyor reverse lever into neutral position. Use a punch about a foot long and ¼ in. in diameter on the end and knock the old pin butt out through the front of the casing. It will fall down into the bottom of the reverse unit housing and will cause no trouble.

Take the new pin to be applied and cut ¼ in off the

front (inside) end and then cut the back end off so that it will come flush with the outside of the casing cover as shown at *a* in the sketch. Next take the cover and have a ¼-in. washer electric welded over each hole as shown at *b*. Then replace the cover after driving the new pins in place so that the washer-covered holes correspond with the new pins.

This makes an excellent temporary job which can be considered as a permanent job, as we have several locomotives here that have been running 18 months with this installation and are O.K. in every way.

FRED W. VOLL, Jr.
Machinist, D. & R. G. W.

Inadequate locomotive inspection

PARAGOULD, Ark.

TO THE EDITOR:

Referring to the letter in the April issue of the *Railway Mechanical Engineer* or inadequate inspection, "A Reader" suggests a means for promoting better co-operation with government locomotive inspectors, with a view to further eliminating reportable government locomotive defects before they are caught and reported by the government inspectors, that the railroads appoint qualified men to be classified as general motive power inspectors working under the direct supervision of the head of the motive power department. Such a suggestion coming from the east seems rather strange, as out on the Missouri Pacific and other western railroads, such company inspectors have been co-operating with the enginehouse supervising forces along the lines suggested for many years. There was a day when some railroads considered the government inspection law a hardship and unwarranted. But that day has long since passed, for up-to-date motive power department officers realize that engine failures vary according to the amount and quality of the work done on the locomotives.

High class locomotive maintenance means reduced fuel consumption, and greater ton-miles per train-hour.

L. SHOWELL.

THE RAILROAD COMMISSION OF WISCONSIN has filed a complaint with the Interstate Commerce Commission, naming most of the railroads of the country as defendants, asking it to prescribe appropriate rules and regulations, under the boiler inspection act, to provide for the equipment of locomotives and tenders used in Wisconsin and other states subject to similar climatic conditions, with suitable cab curtains, as prescribed in the Wisconsin statutes which were annulled by a recent decision of the Supreme Court of the United States on the ground that the Interstate Commerce Commission has complete jurisdiction in the premises. Or, the commission is asked to require "other devices adequate to protect the employees from inclement weather and enable said employees to operate said locomotives and tenders in the active service of such carriers in moving traffic without unnecessary peril to life and limb," as provided by Section 2 of the boiler inspection act. An order is also asked commanding the railroads to cease and desist from "violation" of the boiler inspection act.



Receding chaser collapsible tap

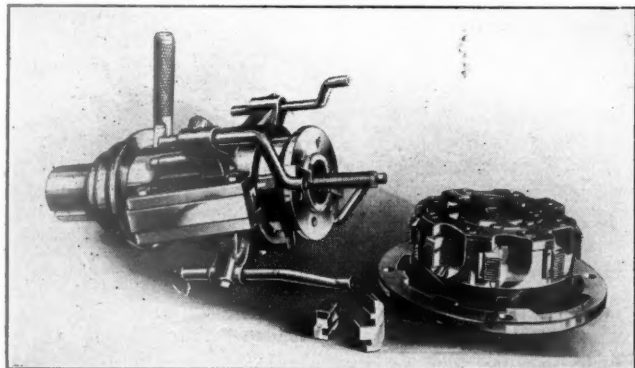
THE Victor M receding chaser collapsible tap designed for cutting tapered threads in pipe couplings, pipe flanges, valve bodies, fittings, etc., has been placed on the market by the Landis Machine Company, Waynesboro, Pa., to replace the present style, in sizes of 4 in. and larger.

The body of the Style M tap includes the cam collar, cam slide, cam, plunger extension, expanding collar, trip

The plunger is of hardened steel. The seats of the slots in which the chaser blocks move are ground to insure a perfect bearing to provide maximum accuracy and life. The trip ring is hardened and ground to provide maximum wear on account of the contact with the work during the tapping operation. The holes, for attaching the trip ring rods, are so placed that the same rods will fit all rings in the same group. A separate trip ring is required for each size of head.

The body of the tap is ground internally and externally. Special length bodies can be furnished as required to suit special jobs, requiring threads longer than the standard length provided in the tap.

The cam collar is a semi-steel casting which carries a camslide and cam. Its position on the body and distance which it moves along the body determines the length of

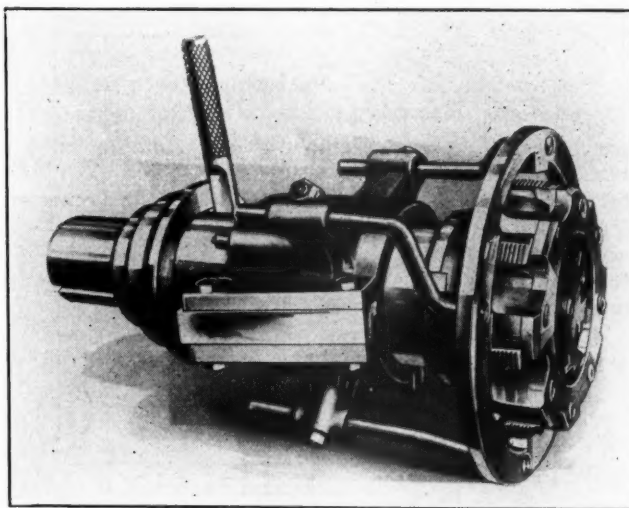


The Landis Style M tap partly taken down

ring rods and minor details. The head includes the plunger, chaser blocks, chasers, tap and trip ring. The head is heat treated and ground all over, including the seat of the chaser block slots. It is bolted to the flanged end of the body by hollow head socket screws placed in the bottom of the chaser block slots. The ground surfaces on both the head and body insure alinement. A heavy key is inserted between the body and the head to take the driving strain.

The chaser blocks are hardened and ground. These blocks are interchangeable among all the heads in the 4-in. to 5-in. sizes and are interchangeable in all the heads included in the 6-in. to 24-in. sizes.

The chasers are all made of high speed steel. The threads are ground after hardening to insure absolute accuracy of form and lead and to give maximum service. The number of chasers used per head is on the basis of one per inch in the even number sizes. The odd number sizes have the same number of chasers as the one size smaller even number. For example, a 7-in. head has six chasers. Chasers for cutting any form of thread can be supplied.



The Victor Style M receding collapsible tap

the thread being cut. A special cam collar is required for cutting threads longer than the maximum length of 4½ in. provided in the tap.

The cam slide which is made of tool steel is inserted in the top of the cam collar and carries the cam as the collar recedes. The cam is also made of tool steel, hardened and ground on all sliding surfaces. The top is milled for cutting any two tapers of thread by proper

pivoting in the cam slide. The cam works between two hardened tool steel gibs inserted in the tap body. Angles are milled on the slides of the cam for contact with the plunger extension. A downward movement of the cam, imparted by the cam collar and cam slide causes the plunger to recede and in turn draws the chasers to produce a tapered thread. Hardened tool steel shoes are set in the plunger extension for contact with the cam.

The expanding collar on the tap is to expand the chasers and set the cam collar in the tapping position when the tap is rotated. A straight forward or downward pressure against the collar will accomplish this. This is usually done by means of a yoke ring engaging the collar on the return movement of the spindle while the tap is in motion.

The Style M tap is regularly furnished for cutting $\frac{3}{8}$ in. and $\frac{3}{4}$ in. taper per foot. Any combination of the two tapers can be provided. A change from one taper to another is made by shifting a bolt in the cam collar and cam slide from one hole to another and changing the chasers. This requires from five to ten minutes' time.

The size adjustment on the chasers is obtained through a screw easily accessible in the front end of the plunger. An adjustment of approximately $\frac{1}{8}$ in. either over or under size can be obtained on each head.

The taps can be used as either rotary or stationary taps. When stationary, the tap is expanded by hand with the operating lever; when rotary, this lever is removed and the expanding collar is used.

Pneumatic wrench for locomotive and car work

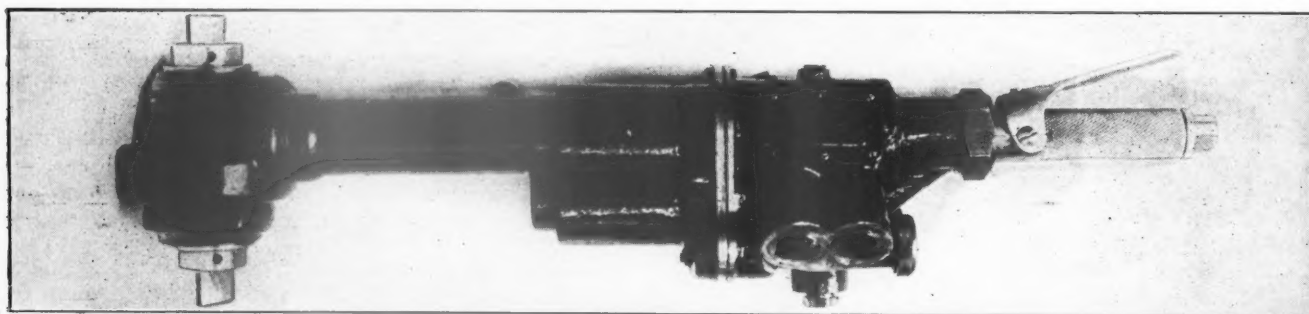
A TOOL designed especially for removing and running up a wide range of nuts from $\frac{1}{2}$ in. to 1 in. on locomotive and car work has been placed on the market by the Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago. The tool is known as the Thor 71R pneumatic wrench.

Several large railroads have thoroughly tested this machine. Some of the tests to which the machine was

seconds for each nut removed by the pneumatic wrench.

On wooden freight cars it was necessary formerly to countersink for the bolt heads. In one test the Thor wrench eliminated counter-sinking entirely by pulling the bolt heads into the wood.

The pneumatic wrench is a one-man tool weighing 25 lb. It allows for the setting of nuts in close quarters quickly and conveniently. The free speed of the ma-



Pneumatic wrench designed for locomotive and car repair work

put are as follows: Removing and running up 1-in. hexagon nuts on locomotive cylinder heads, 26 nuts to each cylinder. The time allowed under the bonus system is 25 min. per cylinder head. The entire job was accomplished by the Thor tool in 10 min., including final tightening. The machine was also tested on front end nuts and found equally satisfactory.

In another test the wrench removed 32 1-in. hexagon nuts from a locomotive cylinder head at the rate of eight

chinese at a pressure of 90 lb. per sq. in. is 90 r.p.m. The overall length of the spindle is $4\frac{7}{8}$ in. and the distance from the center of the spindle to the outside of the case is $1\frac{13}{16}$ in. The distance from the center of the spindle to the extreme end of the throttle is $22\frac{1}{2}$ in. The maximum torque of the machine at the spindle is 756 in.-lb.

The machine can be equipped with various size sockets from $\frac{1}{2}$ in. to 1 in.

A fluxed welding electrode

A NEW type of welding electrode which combines the characteristics of a fluxed electrode and the quality of bead finish and the cleanness in handling of a bare welding electrode has been introduced by the merchandise department of the General Electric Company, Bridgeport, Conn. Recommended for the general welding of steel, the electrode has a uniform flowing quality. The absence of sputtering or spattering, characteristic of the usual commercial bare welding wire, is one of the features of the new material. The

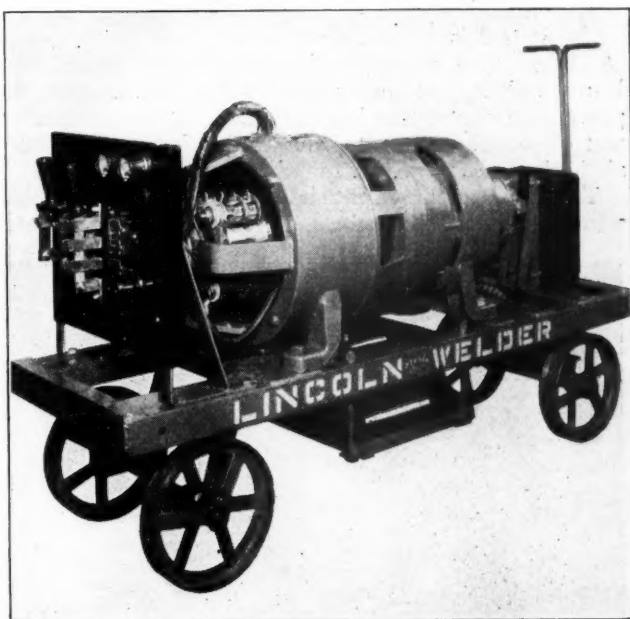
elimination of the erratic arc condition leads to a deposit of more material with the same consumption of electrode per kilowatt-hour. The electrode penetrates quickly and produces high tensile strength and unusual ductility and elongation.

The electrode, which has been designated GE type F, is furnished in $\frac{3}{32}$ -in., $\frac{1}{8}$ -in., $\frac{5}{32}$ -in., $\frac{3}{16}$ -in. and $\frac{1}{4}$ -in. sizes. The standard package is 50 lb., burlapped. It is also furnished on steel reels (approximately 200 lb.) or in coils of approximately 150 or 200 lb.

Welding machine made of welded steel

THE Lincoln Electric Company, Cleveland, Ohio, has made an interesting improvement in the construction of its Stable-arc welding outfits by the substitution of welded structural shapes for iron castings. The illustration shows a 300-amp. a.c. outfit in which only two gray iron castings weighing about 15 lb., have been used. Other sizes and types are being changed over to the steel construction as rapidly as possible. The motor and generator end rings, brackets and connecting ring are all made of structural angles rolled up into the proper shape and welded together. The feet of the motor generator set are made of drop forgings. The truck wheels are made of tee-sections rolled on a special machine. The hub of the wheel is made of steel tube. Control panels are usually made of slate or special non-metallic compounds, but the panel illustrated is made of sheet steel welded together and welded to the two supports.

The underlying idea in this application welded steel construction is to meet the severe conditions to which portable welding equipment is subjected. It is claimed that the steel construction, owing to the fact that it will bend rather than break, reduces the liability of failure; the bent parts may be straightened and the equipment put in operation without waiting for the replacement of castings.



Lincoln arc welding outfit showing how welded joints are used in the truck frame and motor generator frame

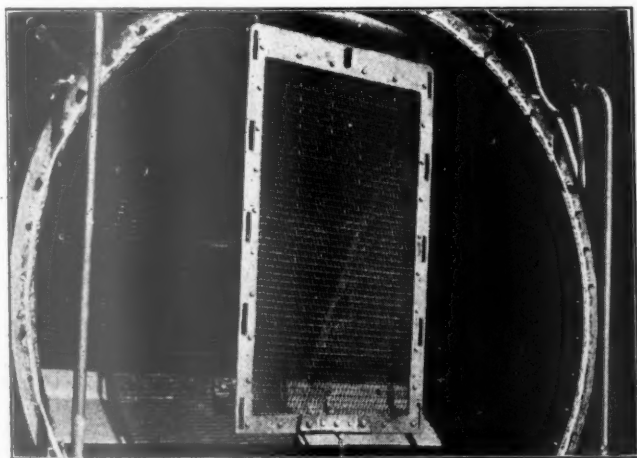
Novel fastening for smokebox netting doors

A NOVEL means for securing smoke box netting doors to the netting frame has recently been invented by B. H. Pedigo, boiler inspector, Illinois Central, Jackson, Tenn., for which he has made patent

The door is closed by holding it against the hooks, raising it until the ends of the hooks engage the top edges of the slots and then allowing it to slide down into position.

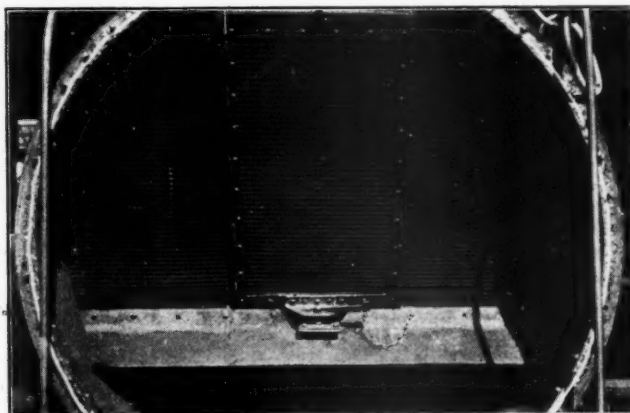
It is securely fastened in place by means of a stud and key located at the bottom of the door as shown in the illustration showing the door closed. The key is secured to the smokebox netting frame by a short piece of fire door chain to prevent its becoming lost when the locomotive is in the shop for repairs.

This door is being tried out by the Illinois Central and



The smoke box netting door swings on one hook when open

application. The object of this invention is to facilitate the application and removal of the door. The door is held against the frame of the door opening by means of hooks, the inside faces of which slope toward the frame so that it rests tight against the frame. Located directly on the center line over the door opening is a hook made of round bar iron which has a short extension arm on which the door hangs when it is open, as shown in one of the illustrations. Slots are provided in the door frame for each hook.



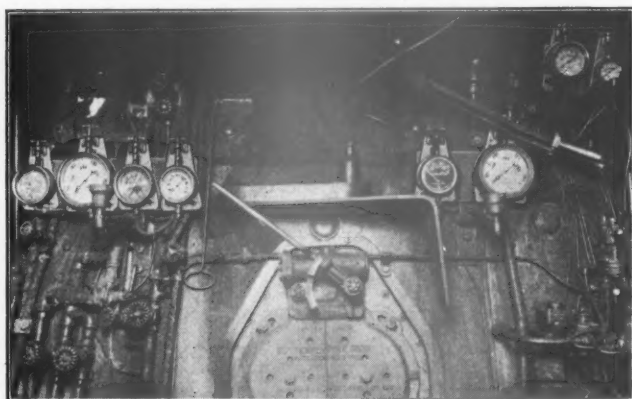
This door can be removed or applied to the front end in less than one minute

the Mobile & Ohio. It is said that netting doors secured by this fastening can be removed or applied in less than one minute.

Swanson steam and air gage holder

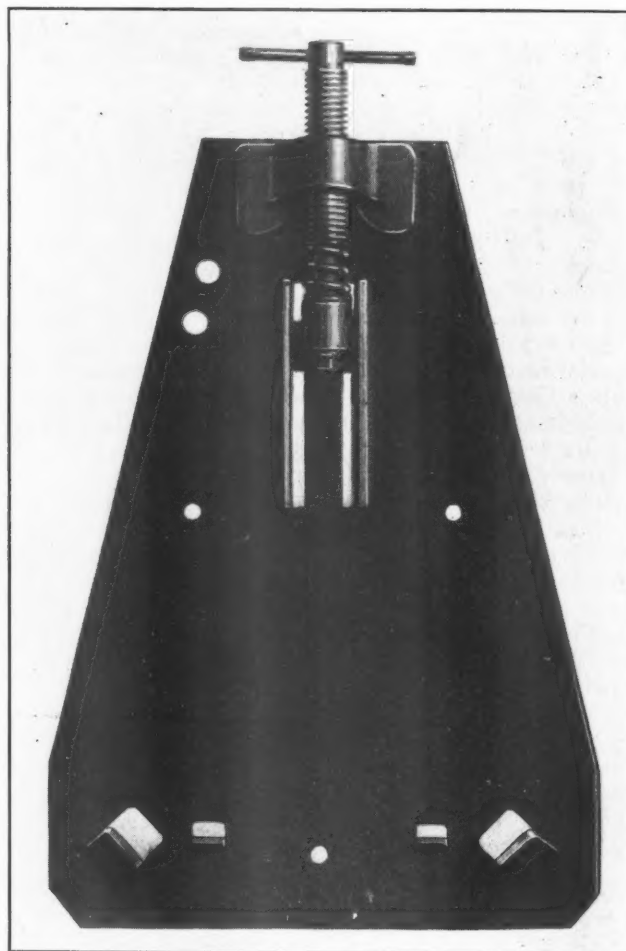
A STEAM and air gage holder for all sizes of gears used on locomotives is now manufactured by the Swanson Company, 1737 Blake street, Denver, Col. The holder secures the gage in place, thus preventing damage to it and eliminating the federal defect of loose gages. It provides for free circulation of air back of the gage.

The screw arrangement shown at the top of the holder, when tightened holds the gage securely in the holder;



A locomotive fully equipped with Swanson gage holders

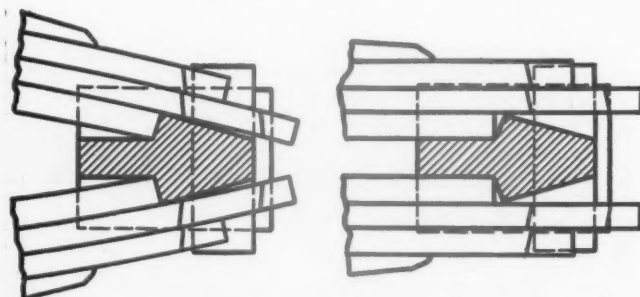
the length of screw allows for variations in the size of gages. The coil spring, which rests on top of the sliding block on the end of the screw, is a positive nut lock that grips the screw arrangement and prevents vibration from working the gage loose in the holder. The sliding block, suitably notched, engages the back flange of the gage when screwed down, compresses the spring and locks the gage. The outward extended prongs on the back of the holder allow for free air circulation back of the gage and eliminate the use of wooden blocks.



The Swanson gage holder

Shackle for the ends of elliptic springs

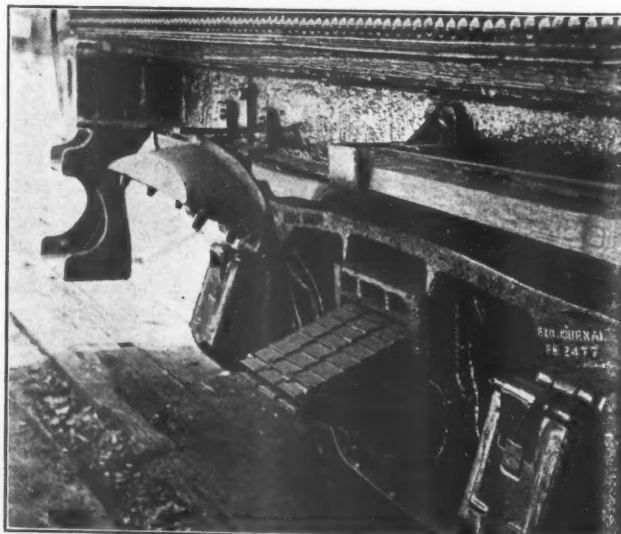
SHOWN in the two drawings is an elliptic spring end support or shackle which was designed and patented by Frank F. Hoeffle, general foreman, blacksmith department, Louisville & Nashville shops,



Left: End of elliptic spring without load—Right: Spring compressed

South Louisville, Ky. This shackle is designed primarily to provide independent supporting surfaces for the main leaves of elliptic springs and at the same time permit flexibility of movement of these leaves to reduce the liability of breaking at the ends.

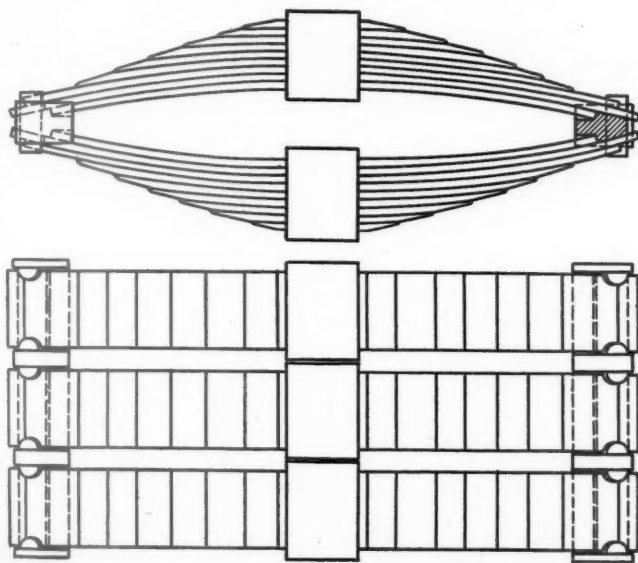
Referring to the drawing showing the end of an elliptic spring, equipped with a Hoeffle shackle, with and



Elliptic springs fitted with Hoeffle shackles applied to a tender truck

without load, the bottom leaf rests on the horizontal plane surface of the block with the end edge butting against the shoulder of the end block. The adjacent leaf projects through the shackle, and rests in a groove in the end block as shown. It is held in position by semi-circular projections or bosses, cast in the side of the groove which fit loosely in two semi-circular notches cut near the ends of the leaf. When the leaves are not compressed the outer extremities of the notches are near or rest against the outer sides of the anchoring bosses, and when the springs are compressed the ends of the base leaves are forced against the shoulders of the end block and pivot horizontally on them as the spring is flattened. As the flattening of the leaves continue, the projecting ends of the leaves are raised from the bearing surfaces of the end blocks and the inner extremities of the notches travel toward the inner side of the bosses. The notches in both leaves, however, remain in flexible anchoring engagement with the bosses. This allowance for free endwise movement of the leaves tends to relieve them from strain at the ends. The ends of these leaves are made relatively thick and are specially heat treated to receive and sustain thrust strains. Placing the notches beyond the bearing portion of the leaves permits the retention of the full resiliency of the spring and the spring structure as a whole is not weakened.

No separate fastening devices are required for anchoring the leaves at the ends so that a flexible, yet substantial, shackle is obtained. Furthermore, the device re-



Application of the Hoeffle shackle to a tender truck spring

quires no special construction of the leaf at the ends which is a factor in reducing failures. This shackle also permits the replacing of any leaf in the spring without dismantling the entire spring.

Provision is made for grouping the springs together as shown in the assembly drawing of the tender truck spring and also in the illustration for bolting the springs together at the ends. This is accomplished by casting two lugs on either side of the end block which are either cored or drilled for a bolt of the necessary length to hold two or more springs.

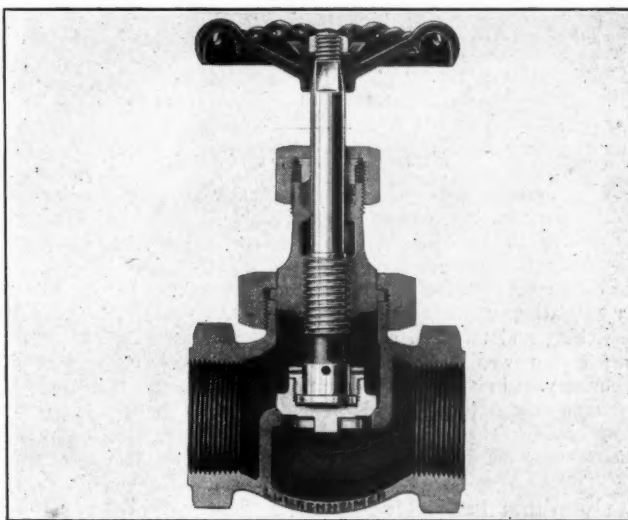
Elliptic springs equipped with these shackles have been in service on the Louisville & Nashville for over 10 years and a considerable reduction in the number of elliptic spring failures has been obtained during that period. This reduction was due largely to the adoption of this type of shackle as approximately 70 per cent of the fail-

ures were caused by the breaking of the main leaves at the ends.

Railroad regrinding valve

THE Lunkenheimer Company, Cincinnati, Ohio has recently developed a bronze regrinding valve particularly adapted for railroad service. These valves are made in the globe and angle patterns in $\frac{1}{4}$ -in. to 2-in. sizes, inclusive. They are intended for 250 lb. pressure and possess an adequate factor of safety at this pressure to meet the most exacting requirements of locomotive and general shop and yard service.

The body walls are heavy, and of special alloy ma-



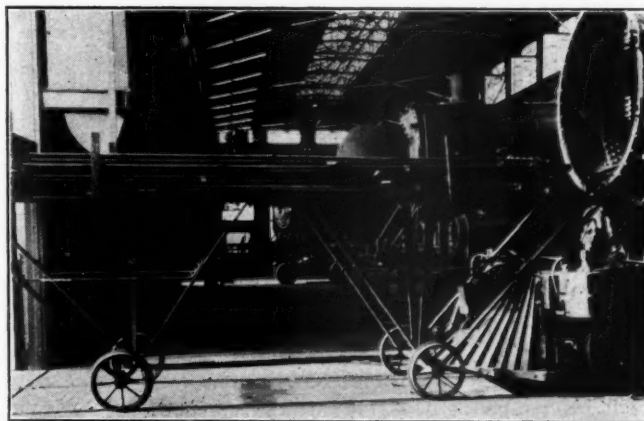
The seating surfaces of this Lunkenheimer valve can be reground without removing the valve from the pipe line

terial; ample flow areas insure free passage with a minimum of friction. The substantial hexagons resist wrenching strains and pipe stresses. The pipe threads are extra long and deep cut.

The handwheel is of a self-cooling type and is made of malleable iron. The union bonnet ring reinforces the valve neck and facilitates regrinding. The seating surfaces can be reground without removing the valve from the pipe line.

All parts of the valve, including the bronze disc, are renewable. The stuffing box can be repacked under pressure. The gland is provided in all sizes.

* * *



Flue wagon used in the locomotive repair shops of the Southern, Birmingham, Ala.

PROMOTIONS AND APPOINTMENTS THE SUPPLY TRADE News of the Month NEW TRADE PUBLICATIONS NEW SHOPS

Domestic railway purchases of locomotives, freight cars and passenger cars

	Locomotives		Freight cars		Passenger cars	
	1927	1926	1927	1926	1927	1926
January	26	60	17,196	11,531	314	217
February	85	13	4,185	11,353	246	152
March	70	407	5,253	8,772	212	112
Total three months.....	181	480	26,634	31,656	772	481

Fuel cost in February

The average cost of railroad fuel coal in February was \$2.69 per ton, as compared with \$2.62 in February last year, according to the Interstate Commerce Commission's monthly summary of railroad fuel statistics. The figures include only fuel for road locomotives in freight and passenger service charged to operating expenses for Class I steam roads, not including switching and terminal companies. The average cost of fuel oil per gallon was 2.98 cents, as compared with 2.90 cents last February. For the two months ended with February the average cost of coal was \$2.71 and the average cost of oil was 2.98 cents. The total cost of coal and fuel oil for the two months was \$56,731,491, as compared with \$55,441,805 last year.

Italy plans larger locomotive, faster freight service

Experts of the Italian State Railways are reported to be examining plans for a new type of passenger locomotive, able to develop 2,000 hp. at driving wheel rims and capable of attaining a speed of 120 kilometers (approximately 75 miles) an hour, states a report to the Department of Commerce from Assistant Commercial Attache A. A. Osborne, Rome.

For express passenger trains on long non-stop runs, there has been planned a new type of tender with holding capacity of 32 cubic meters (8,100 gal.) of water and 7 metric tons (7.7 short tons) of coal. These new tenders are to be used because the State Railways' experts have lately made tests which satisfied them that economy is to be achieved in having freight trains run considerable distances at a speed as high as 40 to 45 kilometers (from about 24 to 28 miles) per hour, without stopping for frequent switching operations at small intermediate stations.

B. & O. to paint locomotives green and name them

Twenty new locomotives which are being delivered to the Baltimore & Ohio by The Baldwin Locomotive Works, will be painted olive green, striped with red and gold and put into service on the passenger trains between Washington and New York. They will also bear the names of the Presidents of the United States, in addition to the usual numerical designation, commencing with the first president. No. 5300 will become the "President Washington"; No. 5301, the "President Adams"; No. 5302, the President Jefferson," down to President Arthur.

The new color scheme, says the announcement, was adopted for these locomotives in order to have the whole train harmonize. The coaches and sleeping cars, as well as the mail, express and baggage cars, in use on the Baltimore & Ohio are olive green and the new locomotives will match this hue, with a little touch of red and gold added to enhance their appearance.

The following parts of the 20 new passenger locomotives will be painted:

Baltimore & Ohio standard coach olive green—

Tender Tank, Cab, Sand Box, Steam Dome, Bell Stand, Cylinder Jacket and Saddle, Cylinder and Steam Chest Head Casings; Engine Truck, Driving and Trailer Truck Wheels, Number Plate, Pilot, Bumper, Boiler

Jacket, Headlight, Tender Frame and Steps, Tender and Trailer Truck Frames, Deck Plates, Air Reservoirs, Pipes, Signal Lamps, Brake Hangers and other miscellaneous parts visible from outside, that require a smooth finish.

Striping—red and gold—

Side of Front Bumper Steps, Cylinder Jacket, Sand Box, Steam Dome, Bumper Pilot, Engine Truck and Driving Wheels, Cab Panels, Sides, Front and Back of Tender Tank at Top and Bottom.

The gold stripes will be $\frac{3}{8}$ in. wide and the red ones, $\frac{1}{4}$ in. wide, with the red stripes inside the gold stripes. In addition to the painting the valve motion, main and side rods will be polished. The names of the locomotives will be in 3 in. gold letters on each side of the cab and the number will be on the head end and headlight in the ordinary form.

Various methods of promoting safety

Several methods of promoting safety which are being employed by the railroads are described in the February news letter of the Steam Railroad Section of the National Safety Council.

During the month of January of each year the maintenance of way department of the Hocking Valley holds get-together meetings at various points on the line, attended by section foremen, track supervisors, supervisors of safety and safety inspectors. Accidents during the previous year and their causes are discussed and preventive methods suggested. In a six months' departmental safety contest which closed on December 31, the motive power department won and was awarded a silver cup.

It is more than 39 months since an employee of the Northwestern Pacific has been killed in an accident while on duty and there were fewer accidents at crossings during 1926 than during 1925. This company is conducting a competitive campaign during 1927 in an effort to make a still better showing.

The safety department of the Baltimore & Ohio will hold a series of safety rallies with entertainment and dances at all of the important cities along its line beginning April 18. The entertainment feature will consist of magic, music and vaudeville sketches which are enacted by employees or members of their families, in addition to community singing and a short address on safety, demonstrated by a motion picture now being produced, entitled "Think Right." This is the fourth series of these entertainments to be given. Heretofore the average attendance has been more than 1,000 at each place.

The New York, New Haven & Hartford has provided 30 flags which carry the words "No Accidents This Month," which are raised at each shop and enginehouse the first of each month. It is flown there until an accident, as defined by the Interstate Commerce Commission, occurs, when it must be hauled down until the first of the following month.

New York Central safety agents have made safety talks in 1,211 schools, before 9,475 teachers and 311,176 pupils.

Erie to spend 25 millions

The Erie road and equipment budget for 1927, presented by President John J. Bernet to the Board of Directors and approved by them totals \$25,401,059, of which \$22,067,812, is chargeable to additions and betterments. The road work planned is to provide facilities for longer trains and heavier motive power which it is estimated will increase train lengths 20 per cent.

The following equipment is among that which is to be retired: 327 locomotives, 270 passenger cars, 4,765 freight cars, 915 tool cars, etc., 25 cabooses. The total book value of the equipment to be retired is \$8,400,101.

New equipment to be purchased includes: 50 heavy Mikado locomotives equipped with automatic stokers and feed water

heaters, 30 switch engines, 25 all-steel suburban passenger coaches, four all-steel dining cars, 25 all-steel express cars and 25 cabooses. The total of new equipment comes to \$8,543,000.

The budget also provides for reconditioning much present equipment to increase its capacity and fuel efficiency. One hundred and fifteen of the road's present Mikado type locomotives are to be equipped with mechanical stokers and feed water heaters. Fifty locomotives are to be equipped for automatic train control.

Meetings and Conventions

Thirty-fourth annual convention of the Air Brake Association

The Air Brake Association will hold its thirty-fourth annual convention May 24, 25, 26 and 27 at the Mayflower Hotel, Washington, D. C. The tentative program as planned includes addresses by Frank McManamy, Interstate Commerce Commission; R. H. Aishton, president, American Railway Association, and Daniel Willard, president, Baltimore & Ohio. In addition to these addresses, there will be a number of important papers and committee reports, the work of some of which has been carried over from last year. The subjects for the various reports and papers to be presented are as follows: Main reservoirs; recommended practice on air brakes and foundation brake gear for gas rail cars; standardization of braking power of freight cars; brake pipe leakage; economical brake cylinder maintenance; recommended practice; freight train handling instructions; retaining valves for freight cars—A.R.A. standard; exclusion of dirt and water from passenger car brake cylinders, and air brakes for automotive vehicles.

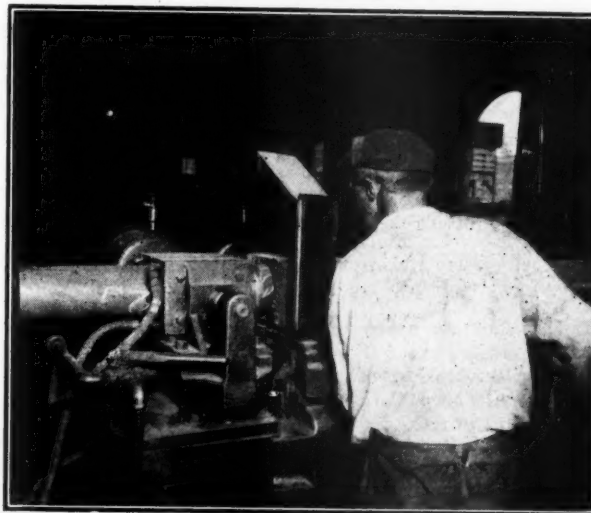
A. S. T. M. holds spring meeting of committees

Following a plan adopted some few years ago, the regular spring group meeting of the committees of the American Society for Testing Materials was held recently at Philadelphia, Pa., preparatory to the presentation of reports to the annual convention of the Society which will take place in June. Twenty-five committees were represented at the meeting and among the reports discussed were a number of special interest to the railroads, which included the reports of the Committees on Steel, J. B. Young, engineer of tests, Reading, chairman; the Corrosion of Iron and Steel, J. H. Gibboney, chief chemist, Norfolk & Western, chairman; Copper Wire, J. A. Capp, chief of testing laboratory, General Electric Company, chairman; Non-Ferrous Metals and Alloys, William Campbell, metallurgist, New York Navy Yard, chairman; Concrete and Concrete Aggregates, C. M. Chapman, consulting engineer, New York City, chairman; Waterproofing and Roofing Materials, S. T. Wagner, consulting engineer, Reading Company, chairman; and Electrical Insulating Materials, H. S. Vassar, laboratory engineer, Public Service Electric and Gas Company, chairman.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

- AIR-BRAKE ASSOCIATION.**—T. L. Burton, acting secretary, 165 Broadway, N. Y. Next meeting May 24, 25, 26 and 27, Mayflower Hotel, Washington, D. C.
- AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.**—C. Borchardt, 202 North Hamlin Ave., Chicago.
- AMERICAN RAILWAY ASSOCIATION DIVISION V.—MECHANICAL.**—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 7, 8 and 9, Hotel Windsor, Montreal.
- DIVISION V—EQUIPMENT PAINTING SECTION.**—V. R. Hawthorne, Chicago.
- DIVISION VI.—PURCHASES AND STORES.**—W. J. Farrell, 30 Vesey St., New York. Annual meeting May 24, 25 and 26, Palmer House, Chicago.
- AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.**—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention, Chicago, August 31, September 1 and 2.
- AMERICAN SOCIETY OF MECHANICAL ENGINEERS.**—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.
- AMERICAN SOCIETY FOR STEEL TREATMENT.**—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.
- AMERICAN SOCIETY FOR TESTING MATERIALS.**—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.
- AMERICAN WELDING SOCIETY.**—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.
- ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.**—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting, Hotel Sherman, Chicago, October 25-28.
- BIRMINGHAM CAR FOREMEN AND CAR INSPECTORS' ASSOCIATION.**—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting, second Monday in each month at Birmingham, Y. M. C. A. Building.

- CANADIAN RAILWAY CLUB.**—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting May 10. Annual meeting and election of officers.
- CAR FOREMEN'S ASSOCIATION OF CHICAGO.**—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago. Next meeting May 9. Paper on handling of inflammable liquids in tank cars on the track and in the ditch will be read by Mr. Innes of the Bureau of Explosives, Dallas, Tex.
- CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.**—F. D. Wiegmar, 720 North 23rd St., E. St. Louis, Ill. Regular meeting first Tuesday in each month, except June, July and August.
- CAR FOREMEN'S CLUB OF LOS ANGELES.**—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.
- CENTRAL RAILWAY CLUB.**—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next meeting May 12, Hotel Statler, Buffalo. Paper on Limited cut-off engine will be presented by H. S. Vincent, Franklin Railway Supply Co.
- CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.**—(See Railway Car Department Officers' Association.)
- CINCINNATI RAILWAY CLUB.**—D. R. Boyd, 811 Union Central Building. Regular meeting second Tuesday February, May, September and November.
- CLEVELAND RAILWAY CLUB.**—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month, except July, August and September at Hotel Hollenden, East Sixth and Superior Ave., Cleveland.
- INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.**—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting, Hotel Lafayette, Buffalo, N. Y., August 16-18, 1927.
- INTERNATIONAL RAILWAY FUEL ASSOCIATION.**—L. G. Plant Railway Exchange, 80 E. Jackson Boulevard, Chicago. Annual convention May 10 to 13, 1927, Chicago.
- INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.**—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention Chicago, September 6-9, 1927.
- LOUISIANA CAR DEPARTMENT ASSOCIATION.**—L. Brownlee, New Orleans, La. Meeting third Thursday in each month.
- MASTER BOILERMAKERS' ASSOCIATION.**—Harry D. Vought, 26 Cortlandt St., New York. Annual meeting, Chicago, May 3-6, 1927.
- NEW ENGLAND RAILROAD CLUB.**—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston. Next meeting May 10. Annual banquet and entertainment.
- NEW YORK RAILROAD CLUB.**—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.
- PACIFIC RAILWAY CLUB.**—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.
- RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.**—A. S. Sternberg, Belt railway, Clearing Station, Chicago. Annual convention Hotel Sherman, Chicago, August 23, 24 and 25.
- RAILWAY CLUB OF GREENVILLE.**—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.
- RAILWAY CLUB OF PITTSBURGH.**—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.
- ST. LOUIS RAILWAY CLUB.**—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August. Next meeting May 13 at Hotel Statler. A. J. Jensen, president, Hanna Engineering Works, will present a paper on "This is the age of riveted steel." Illustrated by motion pictures.
- SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.**—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meeting third Thursday in January, March, May, July, September and November.
- TEXAS CAR FOREMEN'S ASSOCIATION.**—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings first Tuesday in each month, Terminal Hotel bldg., Fort Worth, Tex.
- TRAVELING ENGINEERS' ASSOCIATION.**—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September, 1927.
- WESTERN RAILWAY CLUB.**—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August. Next meeting May 17, Hotel Sherman, Chicago. Annual dinner. Speaker Max Mason, president. University of Chicago.



Safe ending a superheater tube in an electric flue welder

Supply Trade Notes

J. G. Carruthers, has been elected vice-president of the Otis Steel Company, Cleveland, Ohio.

Joseph E. Hodgkins has been appointed manager, and Anthony D. Weber, assistant manager of Jenkins Bros., Boston, Mass.

The Pittsburgh Testing Laboratory has removed its New York City office and laboratory from 50 Church street to 72 Washington street.

The Pullman Car & Manufacturing Corporation has purchased a controlling interest in the Dickson Car Wheel Company, Houston, Texas.

The Bird-Archer Company has removed its offices from 33 Rector street to the Corn Exchange Bank building, 1 East Forty-second street, New York City.

The Chambersburg Engineering Company, Chambersburg, Pa., has opened an office at 613 Machinery Hall, 549 West Washington street, Chicago, under the direction of D. M. McDowell.

The W. N. Thornburgh Manufacturing Company, Cicero, Ill., has purchased the dust guard business of the Lacey Williams Company, Cleveland, Ohio, and will manufacture this product under its own name.

Mudge & Co., Chicago, has awarded contracts for an addition to its manufacturing plant at Chicago. When the extension now under construction is completed, the plant will have double the productive capacity of the present plant.

A. P. Hagar, marine engineer of the Safety Car Heating & Lighting Company, with headquarters at New York, has been appointed representative, with the same headquarters, reporting to the manager of the northeastern district sales office.

H. A. Cronmiller has been appointed a representative of the O. M. Edwards Company, Inc., with headquarters at the New York office of the company, 412 Broadway, to succeed A. J. Horgan. Mr. Cronmiller has served for a number of years at the home office of the company, Syracuse, N. Y.

The Cleveland (Ohio) district offices of the Combustion Engineering Corporation, Ladd Water Tube Boiler Company and the Heine Boiler Company have been consolidated and will be located at 1107 Guardian building. Frank Henderson is Cleveland district manager of these three associated companies.

The Equipment Sales Corporation, Railway Exchange building, St. Louis, Mo., has been appointed sales representative for the Flannery Bolt Company of Pittsburgh, Pa. J. P. Armstrong, with office in the Balboa building, San Francisco, Cal., represents the Flannery Bolt Company, in the San Francisco district.

At a meeting of the board of directors of the Gould Coupler Company, on April 7, G. L. L. Davis was elected vice-president in charge of sales, with headquarters at 250 Park avenue, New York. For the past 17 years Mr. Davis has been with the Scullin Steel Company, St. Louis, Mo., as vice-president in charge of sales.

W. O. Forman, until recently mechanical superintendent of the Boston & Maine, has entered the service of Manning, Maxwell & Moore, Inc., as assistant to Vice-President Frank J. Baumis. For the present he will specialize in factory operations and methods at the Putnam factory, Fitchburg, Mass., and the Shaw factory at Muskegon, Mich., of Manning, Maxwell & Moore, Inc.

A. H. Elliot, for many years in the sales organization of the American Brake Shoe & Foundry Company, New York, has been elected a vice-president of the Southern Wheel Company, with headquarters at New York City. The Southern Wheel Company is a subsidiary of the American Brake Shoe & Foundry Company. Its general offices have been removed from Pittsburgh, Pa., to 3002 Grand Central Terminal, N. Y.

Howard E. Oberg is now in charge of sales engineering in the Middle West for the complete machinery line of the Billings

& Spencer Company, Hartford, Conn. Mr. Oberg's headquarters are in the General Motors building, Detroit, Mich. J. H. Coyle, supervisor of engineering, has been placed in direct charge of sales engineering in New York, Pennsylvania and New England. His headquarters are at Hartford, Conn.

A. R. Chalker, chief draftsman of the Locomotive Stoker Company, Pittsburgh, Pa., has been appointed mechanical engineer with headquarters at Pittsburgh, to fill the vacancy caused by the recent death of L. E. Osborne. Mr. Chalker received his education at Boardman Manual Training High School and his technical training at Yale University, having been graduated from Sheffield Scientific School with the mechanical engineering class of 1906. Mr. Chalker was formerly employed by the Baldwin Locomotive Works and the General Electric Company. In 1911 he entered the employ of the Locomotive Stoker Company and was appointed chief draftsman in 1916. C. R. Davison, who has been doing

special engineering and designing work in the engineering department of the Locomotive Stoker Company since 1917, has been appointed chief draftsman, at Pittsburgh, to succeed Mr. Chalker.

Ernest L. Estes, railway salesman for E. I. duPont de Nemours & Co., chemical products division at Parlin, N. J., has been appointed district manager railway sales, with headquarters at St. Paul, Minn. Mr. Estes was born on December 14, 1887, at Kansas City, Kan. After completing his education in the schools of Kansas City, he entered railway service on the Kansas City Southern in September, 1904, as clerk in the local freight office at Kansas City, Mo., and served with that company continuously until May, 1923, in the general office as clerk in the engineering department, the office of the vice-president and general manager, correspondent and pass clerk in the president's office and the last five years as

chief clerk to the purchasing agent. From August, 1923, to February, 1924, he was manager railway sales for the Dallas Hardware Company of Dallas, Texas, and then resigned to go as railway salesman with the E. I. duPont de Nemours & Co., with headquarters at Kansas City, Mo.

Irving Williams, representative of William Sellers & Co., Inc., Philadelphia, Pa., died on March 11, at his home in Harrisburg, Pa., following an illness of two months' duration. Mr. Williams was graduated as a mechanical engineer at the Massachusetts Institute of Technology in 1903. He entered the employ of the Pennsylvania Railroad as special apprentice at the Altoona shops, and was later promoted to various positions including motive power inspector, assistant storekeeper, enginehouse foreman and assistant master mechanic. In 1925, he became associated with the injector department of William Sellers & Co., Inc.

Arthur Simonson, sales manager of the steel foundry department of the Falk Corporation, Milwaukee, Wis., has been elected



A. R. Chalker



E. L. Estes

vice-president. He was born in Sheffield, England, and received his apprenticeship at the works of Edgar Allen & Co., Ltd., Sheffield. In 1900 he came to the United States as a representative of Alexander Tropenas, inventor of the side blow converter, and installed the process in various plants. Later he became general foundry superintendent of Wm. Wharton, Jr., & Co., Inc., Philadelphia, Pa., and in 1910 he entered the employ of the Falk Corporation where he has held various positions in the steel foundry. In 1916 he was appointed sales manager of the steel foundry department, which position he has held until his recent election.

David H. Moore, electrical engineer, and assistant to the secretary of the Ohio Brass Company, Mansfield, Ohio, since the fall of 1925, has been appointed district sales manager with headquarters at 50 Church street, New York City. He will handle steam railroad accounts in parts of New York, New Jersey, Pennsylvania and the New England States. Mr. Moore spent seven years with Day & Zimmermann, Inc., Philadelphia, in consulting and general engineering work, before going to the Ohio Brass Company, and for eight years prior to that was connected with the Schenectady and Pittsfield works of the General Electric Company.

Blake C. Hooper has been appointed manager of railroad sales of the Baker-Raulang Company, Cleveland, O., manufacturers of Baker electric tractors, trucks and cranes. Mr. Hooper has been



B. C. Hooper

connected with the Baker organization for several years as secretary-treasurer of the Minnesota Supply Company, St. Paul, Minn., which is the Baker representative in that territory. Mr. Hooper is a graduate mechanical engineer, having attended Armour Scientific Academy and Armour Institute of Technology. Upon leaving college he entered the service of the Chicago, Rock Island & Pacific which company he left in 1908 to take a position in the drafting department of the Railway Materials Company, Chicago. He was assistant superintendent of the Toledo, O., plant until June, 1909, returning to the general offices at Chicago as mechanical engineer and later as plant superintendent. In 1912, Mr. Hooper resigned to enter the railway supply field, and has been engaged in selling technical products to railroads since that date, with the exception of the period of the war, during which he served in the army as a captain.

The Air Reduction Company, Inc., New York, has acquired the Interstate Oxygen Company, a West Virginia corporation with oxygen plants at Wheeling, W. Va., and Steubenville, Ohio, and Portsmouth, Ohio, and the Compressed Gas Manufacturing Company, also a West Virginia corporation, having an acetylene plant at Huntingdon, W. Va.

Edward C. Brown, managing director of the local branch at Buenos Aires, Argentina, of the Dearborn Chemical Company, has been awarded a gold medal by the Institution of Locomotive Engineers for a technical paper which he prepared and presented before the local branch of that organization on the subject "Boiler Feedwaters and Preservation of Boilers." The award was made for the best paper presented before any branch of that institution during 1925. The Institution of Locomotive Engineers is a British organization which was founded in 1911 and incorporated in 1925 with 1,190 members located in 39 different countries throughout the world. Each year the institution awards a gold medal for the best paper presented, a silver and gold medal for the paper adjudged second in merit, and a silver medal for the third. The second award went to the author of a paper presented in Milan, Italy.

John F. Schurch, president of Manning, Maxwell & Moore, Inc.,

New York, has been elected chairman of the board; Charles A. Moore, Jr., vice-president, has been elected president to succeed



J. F. Schurch

Mr. Schurch and John D. Nicklis, manager of the supply department and director of purchases, has been elected a vice-president in addition to his former duties; all with headquarters at New York. Mr. Schurch graduated from the University of Minnesota in 1893. The same year he entered the service of the Minneapolis, St. Paul & Sault Ste. Marie. He served consecutively in the office of the auditor, the general superintendent and in the transportation department, resigning the position of chief clerk to the vice-president in 1905. He was then associated with the Railway Materials Company of Chicago, until February, 1914, when he was elected vice-president of the Damascus Brake Beam Com-



C. A. Moore, Jr.

pany, with office in Cleveland, Ohio. The following June he was elected president of the same company. He resigned later in the same year to become vice-president in executive charge under President T. H. Symington, of the T. H. Symington Company. In June, 1922, Mr. Schurch left the Symington Company to become a vice-president of Manning, Maxwell & Moore, Inc., in charge of sales in the middle west and the west, with headquarters at Chicago. In July, 1925, he was elected president and now becomes chairman of the board. Mr. Schurch served in 1922 as president of the Railway Supply Manufacturers' Association.

Mr. Moore was born on June 23, 1880, at Lynn, Mass. He was educated at St. Paul's School, Concord, N. H., and at Yale University, where he was a member of the



J. D. Nicklis

class of 1903. He took part in the Balkan War with the Montenegrin army for a short period and served overseas in the World War with the Fifty-sixth Artillery as major of regimental operations and reconnaissance officer. He was almost continuously at the front from early July, 1918, until the Armistice. Since the end of the war Mr. Moore has been engaged continuously with Manning, Maxwell & Moore, Inc., having served as vice-president for the past three years.

Mr. Nicklis graduated from the public school of Buffalo, N. Y., was honor military graduate at St. John's School, Manlius, N. Y., and

for two years studied at Buffalo Law School. Mr. Nicklis was employed by the Brooks Locomotive Works, Dunkirk, N. Y., as timekeeper, and later was transferred to the purchasing department. He served for two years in the purchasing department of the American Locomotive Company. In 1912 he was appointed manager of the mill supply department of Manning, Maxwell & Moore, Inc., and in addition to these duties was later made director of purchases of the subsidiary companies of that firm. Mr. Nicklis served during the World War for a period of two years as president of the National Supply & Machinery Dealers' Association.

T. L. Miller, who has been in charge of the Western office of the Tuco Products Corporation at Chicago, has been elected vice-president, with the same headquarters; C. M. Schramm, assistant to the vice-president of the Vapor Car Heating Company, Chicago, has been elected vice-president of the Tuco Products Corporation, with headquarters at the same point, and Carl H. Kadie has been appointed southeastern representative of the company, succeeding Frank N. Grigg. Mr. Kadie was born on November 27, 1878, in Trinidad, Colo. After completing a high school education, he entered the service of the Colorado & Southern in January 1896 as a machinist apprentice. He completed his apprenticeship in 1900 and until 1903 was employed as a machinist on the Atchison, Topeka & Santa Fe, the Union Pacific and Southern Pacific. During the period from 1903 to 1906 he was enginehouse foreman, machine shop foreman and general foreman on the Colorado & Southern, the Denver & Rio Grande, the Chicago & Alton and the Hicks Locomotive Works. In 1906 he became erecting shop foreman of the Southern at Birmingham, Ala., eight months later being transferred to Spencer, N. C., as shop superintendent. He served continuously as shop superintendent and master mechanic until 1913 when he resigned to enter the railway supply business.

Charles R. Long, Jr., vice-president of the Okadee Company and president of the Chas. R. Long, Jr., Company, also has been elected president of the Viloco Railway Equipment Company. M. H. Oakes, formerly representative of the National Refining Company, with headquarters at Chicago, has been elected vice-president of the Chas. R. Long, Jr., Company, the Okadee Company and the Viloco Railway Equipment Company. G. E. Johnson, assistant secretary of Viloco Railway Equipment Company and the Okadee Company, has been appointed secretary of these two companies. Mr. Oakes served his apprenticeship as a railroad machinist on the Norfolk & Western and was appointed roundhouse and division foreman on the same road in 1903. Later he became an engine house foreman of the Baltimore & Ohio at Washington, Ind., and was promoted from that position to master mechanic at Grafton, W. Va., in 1911. In the latter year he was appointed master mechanic of the Texas & Pacific at Big Springs, Texas, resigning to become shop superintendent of the Chicago Great Western at Oelwein, Iowa, in 1916. In 1918 he became a member of the Conference Committee of Railroad Managers and when this committee was abolished in 1921 he became associated with the National Refining Company in the railroad department as representative, which position he held until his recent appointment. Mr. Johnson entered business as a representative in the railroad sales department of the Crane Company, Chicago, in 1912, and resigned in 1923 to enter the employ of the Viloco Railway Equipment Company and the Okadee Company. After holding various positions with these two companies he was promoted to assistant secretary.



M. H. Oakes

Trade Publications

INDUSTRIAL FURNACES.—A convenient pocket catalogue of Stewart industrial furnaces and annealing equipment has been issued by the Chicago Flexible Shaft Company, 5600 West Roosevelt Road, Chicago.

ANTI-SLIP TREADS.—The structural features of Feralun anti-slip treads for terminal buildings, stations, car steps, platforms and door saddles are shown in bulletins issued by the American Abrasive Metals Company, 50 Church street, New York.

AUTOMATIC TAPPING MACHINE.—The Garvin No. 2-X automatic tapping machine is fully described and illustrated in Circular No. 7000 issued by the Western Machine Tool Works, Holland, Mich. This machine is equipped with Timken tapered roller bearings.

AIR COMPRESSORS.—The Pennsylvania Pump & Compressor Company, Easton, Pa., has published bulletin No. 132 descriptive of its single stage air compressors and vacuum pumps. The Class 3-AE compressors described in this bulletin are direct synchronous motor connected.

WELDING AND CUTTING EQUIPMENT.—The 1927 Junior Catalogue of the Smith Welding Equipment Corporation, 2619 Fourth street, S. E., Minneapolis, Minn., describes and illustrates Smith's welding and cutting equipment. The catalogue contains 32 pages and is of a convenient pocket size.

TWIST DRILLS, REAMERS, ETC.—A complete line of twist drills, reamers, milling cutters and other miscellaneous small tools are illustrated in Catalogue No. 39 issued by the Whitman Barnes-Detroit Corporation, 2056 West Fort street, Detroit, Mich. The sections of the catalogue are thumb indexed.

OXYGEN MANIFOLDS.—Airco Davis-Bournonville oxygen manifolds of standardized construction are described in catalogue section No. 6, issued by the Air Reduction Sales Company, New York. These manifolds are made in stationary and portable types and can be provided for any desired number of cylinders.

CAR WHEEL GRINDING.—A few records and statements compiled by the mechanical engineers of railways are contained in a 28-page brochure prepared by the Norton Company, Worcester, Mass. These data show the advantages of car wheel grinding and indicate the savings that can be made by the use of the Norton car wheel grinding machine.

MILLING MACHINES.—The Brown & Sharpe Manufacturing Company, Providence, R. I., has issued an 8½-in. by 11-in. catalogue (No. 11A) of 160 pages, completely listing a line of milling machine tools, which include universal and plain machines of various sizes for toolroom and production work, vertical spindle machines, and three types of automatic machines for the production of duplicate parts.

CARNEGIE BEAM SECTIONS.—The 1927 comprehensive handbook on Carnegie beam sections has been made available by the Carnegie Steel Company, Pittsburgh, Pa. The subject matter treats of the profiles and dimensions, elements and properties and the beam and column safe loads of Carnegie sections in accordance with the specifications of the American Institute of Steel Construction and of the Cities of New York and Chicago. The pages are well illustrated and interspersed with tables of data and formulae which should prove of great value to construction engineers.

WORTHINGTON FEEDWATER HEATER.—A booklet designed to assist railroad enginemen in the operation of the Worthington locomotive feedwater heater has just been issued by the Worthington Pump & Machinery Corporation, 115 Broadway, New York. The first section of this vestpocket size booklet, BK-1617, shows the benefits derived by the engineman through the use of the feedwater heater. The next two sections contain instructions for the operation of the heater and the best methods of handling operating troubles on the road. The last section gives Worthington heater cab gage indications.

Personal Mention

General

C. B. SMITH, assistant to the mechanical superintendent of the Boston & Maine, with headquarters at Boston, Mass., has been appointed engineer of tests.

CHARLES W. QUINN has been appointed mechanical inspector of the Boston & Maine, with headquarters at Boston, Mass., succeeding James S. Clarke, promoted.

I. C. BLODGETT, assistant to the mechanical superintendent of the Boston & Maine at Boston, has been appointed supervisor of schedules, reporting to the assistant to the mechanical superintendent.

A. K. GALLOWAY, district master mechanic of the Baltimore & Ohio, with headquarters at Baltimore, Md., has been appointed superintendent of motive power of the Western lines, with headquarters at Cincinnati, Ohio, succeeding W. Malthaner, who has been granted a leave of absence on account of illness.

CHARLES H. WIGGIN, consulting mechanical engineer of the Boston & Maine, has retired after 45 years' service with that road. Mr. Wiggin received his education in the public schools of Newmarket, N. H., and at Phillips Exeter Academy, and entered the service of the Boston & Maine in 1882 as a machinist in the Boston shop. In 1885 he was advanced to foreman of the machine department at Boston, and in 1891 became master mechanic of the Concord division at Concord. When the Concord & Montreal was leased to the Boston & Maine in 1895, Mr. Wiggin was appointed master mechanic of the motive power department of the Concord & White Mountain division, serving in that capacity until 1901, when he was transferred to Boston as assistant superintendent of motive power of the Boston & Maine system. From January 1, 1907, until February 1, 1923, Mr. Wiggin was superintendent of motive power, and from the latter date until July, 1924, was mechanical superintendent. In 1924 he was appointed consulting mechanical engineer.

LAWRENCE RICHARDSON, assistant to the president of the Boston & Maine at East Cambridge, Mass., has been appointed mechanical superintendent in charge of the locomotive and car departments, with headquarters at Boston, Mass., succeeding W. O. Forman, who has joined the staff of Manning, Maxwell & Moore, Inc.

Mr. Richardson was born on July 11, 1889, at Shelbyville, Ky. He attended public school at Louisville, Ky., and high school at New Albany, Ind. He is graduate of Cornell, Class of 1910. He entered the Altoona shops of the Pennsylvania in 1907 as a regular apprentice. At the beginning of the war he went into air craft work and, later, into the Naval Aviation Service. After the war he served

successively as assistant supervisor of equipment and supervisor of equipment of the United States Railroad Administration. In 1920 he became mechanical engineer on special work on the Virginian for the American Steel Foundries Company, and in 1923 entered the employ of the Whiting Corporation. In 1925 he became contracting engineer for Dwight P. Robinson & Company, being assigned later to work in connection with the Boston & Maine's new \$4,000,000 unified freight terminals. In August, 1926, he was appointed assistant to the chairman, and in January of this year was appointed assistant to the president.



Lawrence Richardson

J. P. CHRISTIANSEN, who has been promoted to the position of mechanical engineer of the Chicago, Indianapolis & Louisville, with headquarters at Lafayette, Ind., was born on July 16, 1885,



J. P. Christiansen

in Denmark. He received his early education in the grade schools, academy and State Polytechnic Institute in Denmark, immigrating to the United States in 1905. For a number of years Mr. Christiansen engaged in the hardware business and the machinist trade in Colorado, serving then as machinist and erecting foreman for the Charles S. Stickney Gas Engine Works, St. Paul, Minn. In 1912 he entered the service of the Great Northern as a draftsman in the mechanical department at St. Paul. At the beginning of the World War he became mechanical engineer in charge of designing munitions, forge plants, and finishing plants for the Twin City Forge & Foundry Company, and in January, 1919, he returned to railway service as chief draftsman of the Minneapolis & St. Louis at Minneapolis, Minn. In the same year Mr. Christiansen was appointed as a special estimator in the mechanical department of the Great Northern, becoming chief draftsman of that department in April, 1922. Mr. Christiansen remained in this position until his appointment as mechanical engineer of the Monon.

O. P. REESE, who has been appointed general superintendent of motive power of the Central region of the Pennsylvania, with headquarters at Pittsburgh, Pa., was born on May 29, 1876, at

Louisville, Ky., and was graduated from Purdue University in 1898. He entered railway service in August, 1898, as an apprentice for the Louisville & Nashville, which position he held until September, 1900, when he became a draftsman for the Pennsylvania at Allegheny, Pa. From September, 1900, until September, 1901, he was engaged in special work for that road at Fort Wayne, Ind., and then served as a special apprentice until August, 1903. At the latter time he became gang foreman at Allegheny, Pa., and held



O. P. Reese

this position until the following February. From February, 1904, until December of that year, Mr. Reese was foreman of tests for the Pennsylvania at the St. Louis World's Fair, and then until May of the following year was motive power inspector. From May, 1905, until May, 1906, he was general division foreman, and from June, 1908, until June, 1910, was division master mechanic. From this time on Mr. Reese held the following positions consecutively: June, 1910, to September, 1911, assistant engineer of motive power; September, 1911, to May, 1915, master mechanic; May, 1915, to January, 1917, assistant engineer of motive power in the office of the general superintendent of motive power of the same road; January, 1917, until March, 1920, superintendent of motive power of the Central system of the lines west of Pittsburgh, at Toledo, Ohio; March, 1920, to April, 1921, the same position on the Northern Ohio division. From April, 1921, until February, 1924, Mr. Reese was superintendent of motive power of the Illinois division, and from the

latter date until April, 1925, was assistant general superintendent of motive power on the Northwestern region at Chicago. In April, 1925, Mr. Reese was appointed superintendent of motive power of the Eastern Ohio division of the Central region, which position he was holding at the time of his recent appointment.

HENRY H. URBACH, who has been promoted to superintendent of motive power of the Chicago, Burlington & Quincy Lines West of the Missouri river, with headquarters at Lincoln, Nebr., was born on February 4, 1890, at Sutton, Nebr., and attended high school at Liovet, Nebr. Mr. Urbach entered the service of the Burlington on February 18, 1907, as a machinist apprentice at Havlock, Nebr. After finishing the period of apprenticeship, he served as a machinist at the same point until July, 1914, when he was transferred to Alliance, Nebr. The following year he was transferred to Edgemont, S. D., and in April, 1915, was appointed roundhouse foreman at Seneca, Nebr., where he remained until March, 1917, when he was transferred to Alliance. Mr. Urbach was advanced to general foreman at Edgemont during the same year and until May, 1923, he served in that capacity at Alliance and at Denver, Colo. He was then promoted to the position of assistant master mechanic at Galesburg, Ill., where he remained until September, 1923, when he was advanced to master mechanic of the Brookfield division at Brookfield, Mo. Late in 1925 Mr. Urbach was transferred to McCook, Nebr., and in July, 1926, was appointed assistant superintendent of motive power of the Lines East of the Missouri river, with headquarters at Chicago, a position he held until his appointment as superintendent of motive power at Lincoln.



Henry H. Urbach

Shop and Enginehouse

CHARLES FURNESS has been appointed supervisor of enginehouses, with jurisdiction over all points, of the Boston & Maine, with headquarters at Boston, Mass.

ALBERT E. JONES, general foreman in the mechanical department of the Chicago Great Western at St. Paul, Minn., has been promoted to superintendent of shops at Oelwein, Iowa.

H. C. CASWELL, general foreman in the mechanical department of the Wabash at the Detroit (Mich.) terminals, has been appointed superintendent of the Decatur (Ill.) locomotive shop.

Master Mechanics and Road Foremen

E. J. MCSWEENEY, master mechanic of the Baltimore & Ohio at Akron, Ohio, has been advanced to district master mechanic of the Southwest district.

G. B. RIDDLE has been appointed road foreman of engines of the South Carolina division of the Seaboard Air Line, with headquarters at Jacksonville, Fla.

H. J. BURKLEY and J. J. HERLIHY, master mechanics of the Baltimore & Ohio at Glenwood, Pa., and Washington, Ind., respectively, have interchanged positions.

HARRY REES, general foreman in the locomotive department of the Baltimore & Ohio at New Castle Junction, Pa., has been appointed master mechanic at Akron, Ohio.

WILLIAM KEISER, general enginehouse foreman on the Indiana Harbor Belt at Blue Island, Ill., has been promoted to the position of master mechanic, with headquarters at Gibson, Ind.

G. R. GALLOWAY, district master mechanic of the Southwest district of the Baltimore & Ohio at Cincinnati, Ohio, has suc-

ceeded A. K. Galloway as district master mechanic at Baltimore, Md.

J. O. MCPAKE has been appointed master mechanic of the Toledo, Peoria & Western, with headquarters at Peoria, Ill., succeeding F. R. ECKARD who will continue his duties as superintendent.

DANIEL KARL CHASE, who has been appointed master mechanic of the Pennsylvania, with headquarters at Olean, N. Y., was born on June 1, 1896, at Rehoboth, Del. Mr. Chase is a graduate of the Lewes, Del., high school, Class of 1913, and a graduate of The Pennsylvania State College, Class of 1921. On December 16, 1913, he began his railroad career as a messenger in the transportation department of the Pennsylvania at Philadelphia. He served in this capacity, also as messenger and telephone operator and billing clerk until July 1, 1914, when he began his apprenticeship as a machinist at the Altoona Works. He was promoted to special apprentice on June 16, 1920, and to inspector motive power in April, 1922. He was transferred to the office of general superintendent of motive power in May, 1923, and in November of the same year went to the Meadows shops, Jersey City, N. J., as assistant master mechanic. From January, 1924, until June, 1924, he served as inspector motive power. On the latter date he was transferred to Chambersburg, Pa., as general foreman; in January, 1926, transferred to Wilmington, Md., as assistant master mechanic, and in February, 1926, transferred to the Middle division as assistant master mechanic, master mechanic's office.



D. K. Chase

Purchases and Stores

O. A. SCHULTZ, chief lumber inspector of the Chicago, Burlington & Quincy, has been appointed inspector of stores, succeeding H. R. DUNCAN.

E. L. MURPHY, traveling storekeeper of the Chicago & Alton at Bloomington, Ill., has been appointed assistant general storekeeper succeeding H. O. WOLFE.

W. A. PRUEIT has been appointed stationery storekeeper of the Chesapeake & Ohio, with headquarters at Richmond, Va., succeeding W. B. SMETHIE, resigned.

J. C. DANIELS has been appointed storekeeper of the Richmond car works of the Chesapeake & Ohio, succeeding J. F. TOPPING, who has been assigned to other duties.

H. R. DUNCAN, inspector of stores of the Chicago, Burlington & Quincy, with headquarters at Chicago, has been appointed traveling storekeeper, succeeding C. J. MACKIE, resigned.

H. O. WOLFE, assistant general storekeeper of the Chicago & Alton at Bloomington, Ill., has been advanced to general storekeeper, with headquarters at the same point, succeeding F. C. RILEY, who has been given a leave of absence because of ill health.

Obituary

JOHN MACKENZIE, retired superintendent of motive power of the New York, Chicago & St. Louis, of 2468 Arlington Road, Cleveland, Ohio, died on March 19, in St. Petersburg, Fla. Mr. Mackenzie was a past president of the Central Railway Club and was also a past president of the Master Mechanics' Association. He was instrumental in the drafting and adopting of the present rules of interchange by the master mechanics and master car builders quite a few years ago.